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MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

JANUARY, 1832.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

## Notes of an Observer *on an opinion respecting the Draft in Chimneys; and on another relating to Inertia, which appeared in this Journal.*

In vol. iii. p. 352, of the Journal of the Franklin Institute, there are some very judicious answers given to some queries on the subject of draft in chimneys. I think, however, the author is wrong in his answer to the 5th question. "Will a chimney largest at the top, or vice versa, make the strongest draft?"

Ans. "As that portion of the column of heated air, &c. nearest the burning coals, must necessarily be more expanded, and require more room than at the top of the chimney, where their temperature and volume are diminished, a chimney largest at the bottom must be better calculated to promote a rapid current through it, than the same chimney with its apex reversed." The reason here given is extremely plausible, but I would not rely on it, without experiment, for the following reasons. First, if the upper part of the chimney is enlarged, the friction will be diminished by the diminished velocity. Second, it is highly probable that elastic fluids flowing through tubes, have their flow increased by expanding tubes—on the principle of Venturi's adjutages. [See vol. iv. p. 282 of this journal. See also experiments of the Institute, hereafter to be published.] Because, from the very nature of inertia, whatever velocity may be generated in the lower part, if contracted, it inclines to preserve the same in the wider part above, and thus to increase the draft.

However this may be, I have one remark to make which will be useful to those whose houses smoke in windy weather, or whose furnaces draw worse in windy weather than in calm.

Let a roof, or inclined plane, be made of tin, or sheet iron, or boards, from the top of the chimney walls, outwards and downwards, at an angle of 45 degrees with the perpendicular walls; extending two or three feet from the top each way, more or less, according to the size of the chimney. With such an arrangement at the top of a chimney, the draft will be greatly increased by a strong wind. The experiment has been tried at the suggestion of the writer of this paragraph, with complete success. The modus operandi is obvious. The more violently the wind blows, the more will the weight of the column of air over the chimney be lifted up by the oblique direction given to it by its striking against the plane; that is, a partial vacuum will be created exactly over the top of the chimney.

It is known that a draft in a chimney may be increased by letting into it highly condensed steam, through a pipe opening upwards: and I have been told by practical engineers, that a greater effect is produced by letting the pipe open low down in the chimney, than near the top.

The reason appears to me to be that the velocity given to the gases in the chimney near the bottom, is nearly preserved throughout its whole extent by the nature of inertia.

It might be curious to inquire, what is the velocity with which air moves upwards in a chimney of a given height, with a given temperature above the air on the outside. Now it is known that if the atmosphere were of a uniform density, equal to that at the surface of the earth, it would be twenty-seven thousand feet high. If a body were to fall freely in vacuo from this height to the earth, it would acquire a velocity of thirteen hundred and thirty feet per second, and this is the velocity with which air would rush, by its own pressure, into a vacuum.

It is also known that the velocity with which fluids are discharged under different pressures, is as the square roots of those pressures; that is, four times the pressure will give double the velocity, and nine times the pressure three times the velocity, &c. If there is pressure both ways, as in the case of one fluid rushing into another, with different heads of pressure, then the velocity will be proportional to the square roots of the differences of pressure. For example, suppose two vessels filled with water, one twenty-seven thousand feet high, and the other sixteen feet higher, and a communication made between these two vessels, either near the top or bottom, the fluid would be discharged with a velocity due to a head of sixteen feet. For the writer of this article demonstrated by experiment, (see this Journal, vol. ii. p. 61,) that water makes no resistance to water issuing under a given head. The same law will apply to the gases; consequently the resistance at the top of the chimney to the issuing air is nothing. If, now, we ascertain how much less air there is in a chimney in consequence of its rarefaction by heat, we shall be able to calculate the velocity with which the external air moves upwards into it, by the following very simple rule—*Multiply the square root of the number of feet which the chimney contains in perpendicular height, less than a column of air of the same height on the outside, by eight, and the product will be the velocity in feet per second with which the air will move*

*into the chimney.* Now it is known that air, at the temperature of thirty-two degrees of Fah. has its bulk doubled by an increase of four hundred and eighty degrees of temperature. Suppose, for example, that a chimney is thirty-two feet high, and the temperature of the air on the outside is thirty-two degrees, and the temperature of the air in the chimney, at a mean, four hundred and eighty above thirty-two, then will the quantity of air in the inside of the chimney be only one-half of what it is in a column on the outside of similar height. The difference of head then will be sixteen feet. The square root of sixteen is four, and this square root multiplied by eight, the product is thirty-two, which is the velocity with which the air moves per second into the chimney.

Again, suppose the chimney is eight feet high, and the temperatures as before. Then will the quantity of air on the outside be four perpendicular feet more than that in the chimney. The square root of four is two, and two multiplied by eight is sixteen, which is the velocity of the air passing into the chimney. Again, suppose the chimney to be two feet high, and the temperatures as before, then will the difference of head be one foot, and the square root of one is one, and one multiplied by eight, is eight—the velocity per second, in feet, with which the external air moves upwards into the chimney.

As the temperature of the air on the outside of the chimney is not always thirty-two, it is desirable to know what the volume of such air would be at thirty-two.

It may be obtained by the following rule. First, for temperatures above thirty-two. *Add the number of degrees of Fah. above thirty-two, to four hundred and eighty, and divide four hundred and eighty times the volume of air on the outside of the chimney by the sum, and the quotient will be the volume of air at the temperature of thirty-two.* Again for temperatures below thirty-two. *Subtract the number of degrees of Fah. below thirty-two from four hundred and eighty, and divide four hundred and eighty times the volume of air on the outside of the chimney by the remainder, and the quotient will be the volume of air at the temperature of thirty-two.*

As we have now before us data for calculating the velocity with which air rushes into a chimney at any temperature without and within, we will illustrate the rules by one more example. Let the chimney be 32 feet high, and the temperature on the outside be 60 degrees above, and in the inside 480 degrees above 32. Now let 480 times 32 be divided by 480 added to 60, and the quotient will be $28\frac{4}{10}$ feet, the column of air on the outside at the temperature of 32. Again, let 480 times 32 be divided by 480 added to 480, and the quotient will be 16 feet, the column of air in the inside of the chimney at the temperature of 32; therefore, the difference of the heads of pressure in this case is 16 subtracted from 28.4, which is 12.4.

If, now, according to the rule given above, the square root of 12.4 be multiplied by 8, the product will be $28\frac{17}{100}$ feet, the velocity with which air at a density due to the temperature of 32, will flow into a chimney at the above temperatures.

In these calculations no allowance is made for friction along the sides of the chimney, and in passing through the fuel at the entrance. Neither has any notice been taken of the fact that the gases which pass up the chimney, after having performed the office of combustion, are always of greater weight than the air which enters.

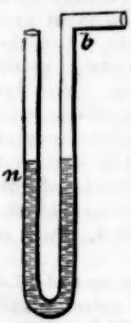
Even when pure dry carbon is the fuel, if all the oxygen of the air which enters, unites with it, the gas which ascends in the chimney is seven and a half per cent. heavier than the air which performs the combustion; and this alone will always diminish the velocity of the entering air more than seven and a half per cent, for that much more matter has to be put in motion with a velocity greater than that of the entering air.

If wet materials are used for combustion, the diminution of velocity will be much greater.

It will be seen from the above examples, that a chimney thirty-two feet high, gives a velocity only double that of one which is one-fourth as high, and only four times greater than that of one which is one-sixteenth as high. And in general the velocity of air moving up chimneys of different heights, with the same mean temperatures, neglecting friction, is as the square roots of their heights.

These calculations are all made on the supposition that the chimney is of the same diameter throughout. The writer believes the draft would be increased below if the chimney should be widened out a little above the fire; but the exact form, best suited to produce the greatest effect, must be ascertained by experiment. This much may be said, that if the object should be to burn as much coal as possible in a chimney of a given height and diameter, so as to produce the most intense heat possible by a natural draft, the chimney should be of a shape somewhat like Venturi's adjutage, with the fire in the "contracted vein."

If the principles explained above are clearly comprehended, it will be extremely easy to understand another method of ascertaining the velocity with which air rushes up a chimney at any moment, which I now proceed to explain.




Let a tube of glass, of any convenient diameter, of equal bore throughout, be bent as in the adjoining figure, so that its two legs may be parallel, and one of them, near the top, be bent at right angles, as at *b*. If, now, these two legs be filled to a certain height, *n*, with water, care being taken to keep the legs vertical, and the end *b*, thrust into the chimney just above the fire place, the water will rise in the leg *b*, and sink in the other. Now as water is 800 times heavier than air, if the difference of the heights of the water in the two legs be multiplied by 800, it will give the head of pressure of air on the outside of the chimney above that within.

If this be reduced to feet, and the square root of the feet be multiplied by eight, it will give the velocity of the air rushing into the chimney as before. Suppose the difference of the

height of the water in the two legs is four-tenths of an inch; 800 times four-tenths of an inch is $26\frac{66}{100}$ feet, and the square root of this, multiplied by 8, is 41 feet; which is the velocity with which air rushes into the chimney where the leg of this anemometer is inserted.

As the method by the anemometer gives the actual velocity, free from the uncertainty of friction in the chimney, it will be superior to the former, if no uncertainty should arise from the difficulty of measuring the depression of water in the tube.

I am aware that these calculations are founded principally on theoretical principles, and that they give a velocity about one-sixth greater than Dr. Hutton's experiments on the impulse of air in motion, which appears to me to be the converse of the principles calculated above; yet as experiments differ very widely among themselves, so as to leave great doubt on the subject, and as my calculations are founded on acknowledged principles, I do not hesitate to present them to the readers of the Journal of the Franklin Institute.

In vol. iv. p. 34, there is an essay by Thomas W. Bakewell, Esq. a gentleman who discovers much acuteness of mind on various subjects discussed by him in this journal, which, for that very reason, is the more deserving of notice, since the weight of his authority, if uncontradicted, might with many be considered sufficient to subvert a doctrine which has been universally admitted among philosophers as resting on the immoveable basis of demonstration.

The chief object of the essay under consideration is to show that inertia varies with gravitation. The author says, "If a hundred pound ball were taken to such a distance from the earth as should lessen the attracting force, or weight, to one pound, it would have lost 99 per cent. of its weight or attracting quality, and also 99 per cent. of its impeding quality, inertia, and would therefore be in exactly the same situation as a ball weighing one pound is, when sixteen feet from the earth, and would consequently fall from this point, in one second of time."

Now this is mere hypothesis, and is besides contrary to known facts. For instance, if the author will put himself to the trouble to calculate how far the moon deviates from a tangent to her orbit in one second of time, he will find that instead of falling below it sixteen feet as his doctrine requires, she falls only $\frac{1}{3600}$ of sixteen feet, the exact distance she should fall on supposition that her inertia is undiminished by her removal from the earth's centre sixty times as far as a body at the surface of the earth, where it is known by experiment she would deviate from a tangent sixteen feet in a second of time, provided she weighs only one hundred pounds. For if the received law of gravitation is correct, and Mr. Bakewell seems to admit it, then the gravitation of the moon to the earth, is only $\frac{1}{3600}$ of what it would be if she was at the earth's surface; that is, sixty times as near the centre of attraction; for sixty times sixty is thirty-six hundred.

If Mr. Bakewell is not satisfied with this single fact, which appears to me decisive, let him calculate how far the several planets fall below a tangent to their orbits in a second of time, and he will

find they fall exactly as far as they should do, on supposition that their inertia is neither increased nor diminished by gravitation. The method of making the calculation, a demonstration of which is given in *mechanics*, is the following—*Multiply the number of feet which a planet moves in its orbit in one second of time, by itself, and divide the product by the diameter, in feet, and the quotient will be the number of feet which the planet deviates from a tangent in a second.* It will be found, by calculating according to this rule, that the deviations from the tangents of the orbits of all the planets, are inversely as the square of their distances from the sun. Now if Mr. Bakewell's doctrine is true that inertia is always in proportion to gravitation, these deviations from the tangents should be equal in all the planets in equal times. For he says, "if we suppose the attraction of the earth should be increased a hundred fold, the velocity of a ball, falling sixteen feet, would not be increased or changed, because the inertia, or impeding power, would also be increased at the same rate, and therefore under every degree of gravitating force, or whatever may be the quantities of matter contained in the bodies acted upon by it, the velocity with which they obey it, is as the rule for falling bodies near the earth, sixteen feet the first second," &c.

Again he says, "if the earth were divested of the motion in its orbit round the sun, and, consequently, of its centrifugal force, it would fall to that body under the same law, and commence its career at the same rate that an apple falls from a tree, viz. sixteen feet the first second, &c." For the sake of testing the correctness of this opinion, as well as illustrating the rule given above, let us actually calculate how far the earth deviates from a tangent to its orbit in one second of time; for this is the exact distance it would fall towards the sun in one second, if its projectile force were destroyed. Suppose its distance to be ninety-six millions of miles; its orbit then will be 3.1416 times twice 96,000,000 = 603187200 miles nearly. This multiplied by 5280, the number of feet in a mile, gives 3184828416000 the number of feet in the earth's orbit. This number again being divided by 31557600, the number of seconds in a year, gives 100921 feet, nearly, for the distance the earth moves in her orbit, in one second of time. The square of this last number, that is, the number multiplied by itself, is 10185148241 and this divided by 1013760000000, the number of feet in the diameter of the earth's orbit, gives .01004 feet, the distance which the earth would fall towards the sun in one second, if her projectile motion were destroyed. That is, she would fall but little more than one-ninth of an inch, instead of sixteen feet.

By calculating in a similar manner the distance which Herschell falls from the tangent of his orbit in a second, by the force of the sun's attraction, it will be found to be nearly 361 times less than that of the earth, for Herschell is nearly nineteen times further from the sun than the earth, and 19 times 19 is 361.

Mr. Bakewell says, "a friend of mine thinks that the tides make against my theory; for if the waters on the earth are at all influenced by the moon's attraction, they ought to fall to it at once."

I agree with this friend, and I think if Mr. Bakewell examines again what he has written in answer to this objection, he will find he has said nothing to show the possibility of there being a tide on the opposite side of the earth from the moon.

Indeed some of the consequences of Mr. Bakewell's hypothesis are so evidently absurd, that I cannot imagine how it could have been entertained for a moment by a gentleman who, in some of his subsequent essays, manifested a very acute mind.

For example: If there were only two bodies in the universe, one indefinitely large, the other indefinitely small; for instance, the sun and a grain of sand; by this hypothesis they would fall towards each other with equal velocities, and would move the same distance the first second, when placed one thousand millions of miles apart, as if they were separated only one hundred yards.

According to Kepler's law, which is not hypothetical, but derived from patient observation, the squares of the periodic times of all the planets round the sun are as the cubes of their distances: according to Mr. Bakewell's hypothesis, the periodic times would be as the square roots of the distances. Again, from Kepler's law it is known that the velocities of the planets in their orbits is *inversely* as the square roots of their distances: whereas, by Mr. Bakewell's hypothesis the velocities would be *directly* as the square roots of their distances. Let us take one example. Suppose a planet four times as far from the sun, as the earth, and suppose, according to the hypothesis, it falls from a tangent to its orbit, the same distance as the earth falls, it may be shown by geometry that it must move twice as far in its orbit to be the same distance from the tangent as the earth is, in the same time, which moves in a circle four times less.

In like manner it may be shown that if a planet is nine times as far from the sun as the earth is, it will have to move three times as far in its orbit, to be removed the same distance from the tangent, at the end of a second, as the earth is. Now, according to the law which actually exists in nature, the earth moves three times as fast as a planet which is nine times as far from the sun as itself: whereas, according to the hypothetical law we are examining, the planet would move three times as fast as the earth.

If this article should be successful in freeing an active and ingenious mind from the trammels of a false hypothesis, on a subject of high importance, it will not have been written in vain.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

## Notes of an Observer *respecting the centrifugal force of a body revolving in a given circle.*

In the 5th volume of the Journal of the Franklin Institute, page 52, is the following question—"What is the absolute centrifugal force of a given body, revolving in a given circle, with a given velocity?"

The answer there given is correct, with the exception of 16¼ being

used for $16\frac{1}{2}$. The general reader, however, who is unacquainted with algebraic notation will find the following method of calculating centrifugal force more intelligible.

In mechanics it is demonstrated that if a body moves in a circle, sixteen feet in diameter, with a velocity of sixteen feet per second, its centrifugal force is just equal to gravity; that is, its centrifugal force is equal to its own weight.

It is also shown that the centrifugal force is directly as the square of the velocity, and inversely as the diameter of the circle in which the body moves. From these principles the following very simple rule is derived. *Multiply the weight of the body in pounds by the square of the number of feet passed over in a second of time, then divide the product thus obtained by sixteen times the diameter of the circle in feet, the quotient will be the absolute centrifugal force in pounds.*

For example, "Let one of the balls of a governor of an engine, weigh thirty pounds; and suppose that it revolves in a circle the diameter of which is three feet, in one second of time." Here the number of feet passed over in a second is first obtained by multiplying the diameter by 3.1416, because the circumference of any circle is 3.1416 times greater than its diameter; but three times 3.1416 is 9.42, which is the velocity in feet per second; now square 9.42, and the result will be 88.54. This square being multiplied by 30, the weight of the ball, gives 2656.2. Now divide this quantity by sixteen times the diameter, $16\times3=48$, and the quotient will be 55.33 pounds, the centrifugal force.

If the reader wishes to become familiar with the laws of centrifugal force, let him propose to himself a number of such questions as the following; and first, let the velocity be constant, for example, sixteen feet per second.

What will be the centrifugal force of the ball mentioned above, weighing 30 pounds, in circles of the diameters 16 feet, 32 feet, and 64 feet. He will find the answer to the first question will be 30, to the second 15, and to the third $7\frac{1}{2}$.

Let him then vary the velocity, keeping the diameter the same; for example 16 feet. What will the centrifugal force be with the following velocities, 16 feet per second, 32 feet per second, and 64 feet per second? He will find the respective answers to be 30 pounds, 120 pounds, and 480 pounds. He may then proceed to vary both the circle and the velocity. For example, if the diameter is 4 feet, and velocity 8 feet, he will find the answer to be 30 pounds, or equal to gravity. If the diameter is one foot, and the velocity four feet per second, the answer will be 30 pounds. If the diameter is one foot, and the velocity is eight feet, the answer will be 120 pounds.

By considering the velocities with which pendulums move at their lowest point, in connexion with the above principles, I discovered the following curious law. *If any pendulum oscillates in an arc of a circle, whose cord divides radius into two equal parts, its centrifugal force at the lowest point is just equal to gravity.* In other words, if any pendulum be drawn out of the line of direction until its perpendicular height above its lowest point shall be one-half its own length,

then will the tension of the cord by which it is suspended at this lower point of oscillation be just twice as great as when the pendulum is hanging at rest. This law may be tested by as many examples as the reader pleases. I shall propose two. Suppose a pendulum two feet long drawn up the arc of its circle, until its perpendicular height is one-half its own length; in oscillating it will descend one foot in perpendicular height. Now it is known from the laws of falling bodies, that in falling freely one foot perpendicular height, either in the line of direction, or on an inclined plane, or in a curve as of a pendulum, it will acquire a velocity of eight feet per second, and according to the rules mentioned above, if a body moves in a circle four feet in diameter, with a velocity of eight feet per second, its centrifugal force will just equal gravity. Suppose now the pendulum is eight feet long, and let it be drawn till it is four feet above a line drawn horizontally through the lowest point of the curve. Now this pendulum moves in an arc of a circle which is sixteen feet in diameter, and at its lowest point, according to the laws of falling bodies, its velocity is 16 feet per second, and with such a velocity, and such a circle, its centrifugal force will be found to be equal to gravity.

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TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

## *Description of an improvement in the mode of Balancing Mill Stones.*

Sir,—I offer the following improvement for your consideration, and if you think it worthy, you will please publish it in the Journal of the Franklin Institute. It consists of an alteration in the balance rine and driver, for balancing the running mill stone, obviating the necessity of taking up the stone to remove the rine, and afterwards adjusting the driver so that each prong shall have its full bearing; which improvement will also obviate the necessity of taking out the spindle to adjust and fix the rine and driver as heretofore.

I take a common three pronged balance rine, such as is commonly used, then I rivet, or otherwise secure, a three-cornered box on the under side of the top of said rine, so that each corner may rest on the under side of each prong. On each side of this box I fix a set screw, to act on a small block of iron, steel, or other metal, with a centre hole punched in it to admit of the cock head, or upper end of the spindle to rest in. This small block, by working the screws, will move the running stone, and admit of balancing it on the head of the spindle to any nicety: after the runner is well balanced I apply a sufficient force to the wallower on the spindle to bring up the driver to its bearing. Then I take a common three-pronged driver, and fix each prong askew, so as to stand square with the prongs of the rine on the driving side, then the prongs being no longer than the size of the eye of the mill stone, and when fixed on the spindle the lower side of driver and rine being of an equal distance from the face of the bed stone, I insert, through the driver, on each prong, a set screw to

work against each prong of the rine, and to set the said screws. After the runner is well balanced, I apply a sufficient force to the wallower, on the spindle, to bring up the driver to its bearing; then, with a wrench, I screw up the screws that are wanting to come up to the prong of the balance rine, each to a full bearing, so, as I have before stated, that the runner can be justly balanced, and the driver set to its proper bearing, without any cause of taking out the spindle. I have had one in operation some time, on the above principle; it more than answers my anticipations.

Yours, respectfully,

DANIEL LAMB.

*Almonisson Mills, near Woodbury, N. J. July*, 1831.

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Practical Observations on the good and bad properties of the colours used by artists.* *By* JOSHUA SHAW.

*Philadelphia, December* 28, 1831.

SIR,—Having, in the way of my profession, and by long experience and practical experiment, made myself acquainted with the good and bad qualities of the colours in general use with artists, I am inclined to believe that the results, if made public, would be found of much interest to the profession, as well as to connoisseurs and lovers of the art in general; and believing the Journal of the Franklin Institute to be a useful and legitimate channel through which to furnish the information, I submit the first of a series of remarks, or essays, which I have in contemplation, to your inspection, and which, if approved of, you will please to lay before your readers. You are not to consider my observations as the result of *chemical* experiment in the laboratory, of which an artist, generally speaking, can be expected to know but little; about as much, perhaps, as a chemist generally knows of painting. I pretend to very little knowledge of the art of manufacturing colours, and shall confine myself to their application upon canvass, their disposition to change, or such other qualifications as may render them valuable or otherwise. My limited knowledge of science as applied to chemistry, or to books, does not enable me to say whether I am in the track of any predecessor or not; but it is a fact as plain to me as noon day, that there is an unaccountable difference between the productions of the ancient and modern artists; I speak with reference to colours themselves, and the modes of their application, without the most distant idea of contrasting those merits which belong to composition or design, for in this respect, the balance is certainly with the present generation, notwithstanding any thing which may be said to the contrary by the affected babbling connoisseur, who in every age has been the same dissatisfied malcontent, decrying living merit.

I shall commence with remarks on blues, and the following, to-

gether with the preceding observations, may be given together as constituting the first division of my undertaking.

Prussian blue is a combination of oxide of iron with cyanogen, upon an aluminous base. It is the most common blue in use among artists, and from whom, owing to long acquaintance with it, there seems to be but little chance of an immediate separation—such is the force of habit. Prussian blue is an intensely deep pigment, and cheapness alone must have been the principal cause of its general adoption; however, few, or none, will envy the feelings of the artist who, on that account, shall continue to use it; his reputation must soon suffer from its liability to change, and the penalty thus incurred will be of infinitely greater disadvantage than any difference of price between it and other materials of a more permanent nature. In large compositions, and in portraits, where broad draperies are required, it may be employed to some advantage, if employed in the following manner—it should be reduced with white, and in every part left much lighter than intended to be when finished, and when dry, increased to the proper depth by a thin coat or glazing of Antwerp or fine cobalt blue, by which means it will be protected from the effects to which it otherwise is liable when in contact with atmospheric air, from which it suffers materially, changing by degrees to a dirty olive green. I know not upon what principle this change is effected, but I speak of results, and leave the causes to be explained by those who know more of chemistry than I do.

Its intensity and heaviness are equally against it, and, if there were no other, these should furnish sufficient objections for continuing its use. The least skilful in art, as well as the genuine connoisseur, must have observed in all the works of the old masters, whether good or bad, that all their deeper tones are clear and transparent, and if so after the lapse of a century, it is certain they were equally so when they left the easel of the painter.

With respect to the greater proportion of the works of modern artists, it is evident that their pictures are as remarkable for qualities of a contrary nature, and it may be generally traced to their slovenly disregard as to the purity, or other good or bad qualities, inseparable from the colours they employ.

I shall now dismiss the article of Prussian blue as a totally worthless colour when applied to the fine arts, to make room for a few observations respecting the properties of indigo, the which, although it does not properly fall under the head of the present article, I shall take this opportunity to introduce, as I do not intend to make it the subject of a separate essay. Indigo, I have always been inclined to believe, possessed many superior qualities, and that it would, sooner or later, become a substitute for, and altogether supersede the use of, Prussian blue. It is laid down as a principle by artists generally, that the durability, as to colour, of vegetable preparations, is not to be depended upon; nevertheless, it is a fact, that lake, prepared from madder, is the best and most permanent of all others—why, then, should we despair of indigo? As an article of commerce, it has never been offered in a pure state, and if any experiments have been made

upon it by artists, and have ended in disappointment, I think it must be attributed to the fact, that it contains much of foreign and unfriendly alloy.

The blue vat of the dyer contains indigo deoxidised by protoxide of iron, and rendered soluble, in its yellow green state, by lime water. If a portion of this solution be exposed to the air in a shallow vessel, the indigo will speedily absorb oxygen, and be precipitated in its usual state of an insoluble blue powder; this being dried and digested in a mixture of alcohol and muriatic acid, becomes pure indigo, by the abstraction of all the resin and lime contained in it. Thus prepared, it is a fine powder, intensely deep, but soft and tender in its tint, resembling ultramarine, and does not change when exposed to the air. There is but little doubt that if *pure indigo*, prepared as above, or in any other way more convenient to the chemist, was procurable at the colour stores, it would be found to be a most valuable substitute for the preceding article; for if it will stand the action of light and air, as it certainly does, unprotected by an oily or mucilaginous matter, it would be an acquisition to the palette of no ordinary kind, and prove the most valuable of all other blues when prepared in cakes for wash drawings, and for the use of miniature painters. It is well known that vegetable productions, when they can be depended upon, are, in most instances, preferable to minerals; as applied to water colours they certainly are; they flow freer from the pencil, are more vivid and more convenient to manage.

I am, &c.

JOSHUA SHAW.

*Note.*—If, in the course of my intended remarks, I should be induced to refer occasionally to known pictures, for the sake of making comparisons, and thereby enabling the painter to form his own judgment as to the truth of my observations, it is trusted that no one will take offence. The sole object of these essays is to improve the condition, and not to traduce the standing of the fine arts at home or abroad, my remarks will be general, and apply alike to every country.

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## FRANKLIN INSTITUTE.

### *Explosions of Steam Boilers.*

Continued from vol. viii. p. 388.

### (No. XIV.)

**Extract of a letter from the Hon. S. D. Ingham, late Secretary of the Treasury, dated October 21, 1830.**

I send you herewith a drawing of a boiler intended to prevent the possibility of the upper zone being heated above the temperature of boiling water, with a simple apparatus for announcing to the *crew of the boat*, the successive depression of the water. I submit it for your inspection and criticism, and would be gratified if an experiment could be made by constructing two small boilers, one on this plan, omitting the float and bell as unnecessary for this object, and one in

the usual form of a high pressure boiler, made of metal one-eighth, or one-fourth, stronger than the first, in all other respects as much alike as possible; then place them side by side in a furnace so constructed as to avoid all danger to the attendant, allowing the fire to surround them freely, and force it until they explode; several gauge cocks in each would be necessary to regulate the height of the water, which should be kept as equal as possible. The *water-guard*, as I have termed it, having no pressure on it, could be kept full with a very simple apparatus; and the supply to the boilers could be thrown in with a small forcing pump. The idea of thus surrounding the boiler with an effective nonconductor, was suggested by reading some of the papers of Mr. Perkins, and a commentary upon his experiments by Mr. Arago; but the remedies proposed by the latter appear to be rather auxiliary than effective, and generally liable to the objection that they depend for success upon a degree of care and attention on the part of the engineer, which is scarcely to be expected, or even within the reach of hope in our country. It will certainly be safer to put it out of the power of the engineer to heat the upper part of the boiler to a temperature above that of the water, than to rely upon any precautions, which depend on his care and constant attention, to regulate it by any standard that can be devised. I would not, however, dispense with the safety valves; they should be constructed in the most perfect manner, and their efficiency will be no longer doubtful when the boiler is so constructed that the elasticity of the steam must always correspond with its temperature; this point being secured, the chief remaining danger will be from raising the ordinary steam too high for the strength of the metal; the safety valve, properly constructed and secured, is perhaps the best remedy for this.

*Specification of an improvement on the steam boiler, intended to prevent the explosion of steam boilers, by reason of the great heat in that part of the boiler which is above the water line; and also to give notice of the depression of the water, by the ringing of a bell.*

A, A, The steam boiler filled with water to the line *e*, *e*.

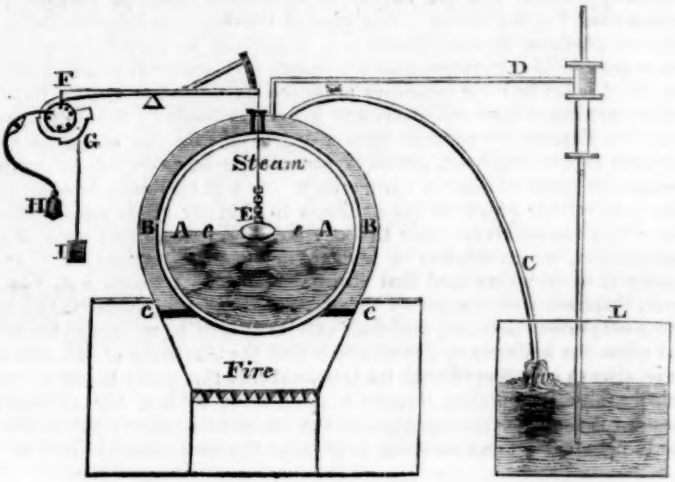
B, B, A column of water on the outer side of the boiler, called a water guard; it is confined by a casing of common sheet iron or copper, around the upper and middle parts of the boiler, meeting the fire at *c*, *c*, and leaving a space of $2\frac{1}{2}$ inches between it and the boiler for the thickness of the column of water. This water being exposed to the atmosphere, cannot be heated above 212°, and extending so far below the surface of the water within the boiler, that no part of the iron which has not water in contact with it, shall be exposed to the fire, guards the upper and middle parts of the boiler from the intense heat communicated through the brickwork.

C, A pipe to discharge the overflowing water into the supply cistern L.

D, A pipe and pump to supply the water guard.

E, A concave spheroidal metallic ball, or float, so adjusted as to

float as in the drawing where the water is at *e*, *e*. A slight depression of the water raises the catch F, when the lock wheel G, propelled by the weight I, turns until the next notch meets the catch, ringing the bell H; a further depression of the water raises the catch, and the rack wheel turns to the next notch, ringing the bell more actively; a further depression of the water raises the catch above the highest notch, when the weight I runs down, ringing the bell with such violence as should be heard in every part of a steam-boat.

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(No. XV.)

Extract of a letter* from Professor James Renwick, of Columbia College, New York, dated

*October* 27, 1830.

"As relates to that part of the improvement called the water guard: There can be no doubt that it would be certainly effectual in preventing explosions arising from the cause pointed out by Perkins, but there are extremely few cases in which it would be possible to introduce it into practice; the water in the outer vessel boiling under the ordinary pressure of the atmosphere, would not of course be heated beyond 212°, and would carry off the heat of the water and steam contained in the inner boiler so rapidly, that it would be impossible to raise their temperature more than a few degrees above 212°; now, even in the English condensing engines, the safety valve

* This letter as well as Mr. Lester's, (No. 17,) was addressed to the Hon. Samuel D. Ingham, (then Secretary of the Treasury,) by whom these extracts were kindly communicated to the committee.

is loaded with three pounds per square inch, and requires steam of a tension greater than could be attained in the proposed apparatus; in our American steam-boats, even when the engine works upon the condensing principle, the safety valve is rarely loaded with less than seven or eight pounds per inch.

"I am myself decidedly of opinion that no absolute security from explosion can be attained, until a feeding apparatus that shall depend for its action solely upon the level of the water in the boiler, and which is applicable to steam of the greatest tension, shall have been invented, and for this it would be a worthy object to offer a national reward. A small separate engine, working a forcing pump, to which the apparatus which received the prize from the British Society of Arts, would answer the purpose, but there are objections to its use, and it does not fulfil the condition I have stated."

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## (No. XVI.)

Extract of a letter from the Hon. S. D. Ingham, late Secretary of the Treasury, dated Nov. 1, 1830.

Since I had the honour of addressing you, I forwarded a drawing of the water guard boiler to Professor Renwick, of New York: he considers the remedy effectual against the chief cause of explosion, but is persuaded that the water in the guard will conduct the heat from the boiler so rapidly that the steam cannot be raised within, without great waste of fuel; this objection had struck me with some force in my first speculations on the subject, but had yielded to the consideration that a column of boiling water would not be likely to conduct heat so rapidly from the boiler as the open air at a much lower temperature; how far it would compare with a mass of brick work in this respect, can only be ascertained by experiment. I have supposed that the water guard would be a better non-conductor than the open air, and that if somewhat inferior to the mass of brick work, the defect would be made up by transmitting the escaping heat to the cistern from whence the boiler should receive its supply of water, while all that escaped into the open air or brick work would be lost. In this speculation I may be mistaken, and having great respect for the Professor's judgment, I should be gratified if you would try the experiment, whether a boiler enclosed in the ordinary form, or one with the water guard, require the most fuel to raise the steam. This objection may, however, be readily removed by constructing the water guard strong enough to bear a pressure equal to that which it is proposed to give the steam in the boiler; it will perfectly regulate the temperature of the iron, and its overflowing, which in that case should be constant, will be the admonition to the engineer that all is right. Professor Renwick is of opinion that the best remedy is a constant supply of water, and the desideratum is a contrivance for self-feeding to be continued while the boat stops: believing, as I do, that it is not the mixture of the whole of the water in the boiler

with all the steam, I cannot be persuaded that the depression of the water would cause an explosion, if the steam above it had not received an increased heat from the iron, and when the steam is so heated, there may be nearly the same danger when the water is at its proper height.

I enclose an extract (No. 15,) from the Professor's letter that you may consider his objections; whatever comes from him is entitled to great consideration.

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(No. XVII.)

Extract of a letter from E. A. Lester, Esq. to the Secretary of the Treasury, dated

*Boston, November* 15, 1830.

"Having never been on board a steam-boat at the time of a boiler's exploding, nor witnessed the explosion of a steam boiler in any other situation, I am not able to give you much, if any, information in answer to your inquiries as requested in your circular of the 1st of August last, or at least none which can regularly be classed in the list of interrogatories; yet, as my experience in the use of steam in various ways, and for different purposes, has brought to my mind and notice certain facts relating thereto, among them, some which I have never seen noticed in any writings on the subject, I have concluded to communicate them to you, leaving it to your discretion to make such use of them as you may think proper.

"My first experience in steam engines commenced in 1814, in the city of Baltimore, where I was employed by Capt. George Stiles in the manufacturing of the rotary steam engines, which were operated by high steam, of great elasticity, being at times from 150 to 200 lbs. per inch pressure. The boilers, or generators, were of different metals and forms, being of copper, of wrought iron, and of composition metal pipes. During the time I was there, no accident, even of burning or overheating a generator or boiler occurred.

"Since my leaving Baltimore, I have been employed in New York, in North Carolina, and in this city, in the building and operating of engines of both high and low pressure, and have repaired many boilers in steam-boats, which had been overheated, but had not exploded. The steam-boat Eagle, of Boston, owned and commanded by Capt. John Wood, having a low pressure, or condensing, engine, with two cylinder wrought iron boilers, with cast iron heads without flues, two feet six inches in diameter, and twenty-four feet in length each, set in brick work, had her boilers very much injured in the bottoms, or under sides. The injury was attributed to negligence in not keeping them clean, a quantity of sediment having collected in the boilers, and settled at the bottom, and formed an incrustation of from two to three inches in thickness, which was, in some places, so hard as to require a hammer and chisel to disengage it from the bottom of the boilers. The metal, for nearly the length of the boilers, was in

consequence so much injured that it became necessary to repair the bottoms with new irons, and to change them; making the parts which were before the under sides, the tops or upper sides, by rolling them in their beds. This damage was sustained in the course of two or three weeks after the boilers were set or put in operation. Whether any explosion would have occurred is uncertain, as the boilers were discovered to leak immediately over the fire in the furnace, and the discharge from those places extinguished the fire.

"A steam-boat with a low pressure engine, called the Massachusetts, of this port, having two cylinder copper boilers, with return flues, was injured by suffering the water to get too low, whereby the flues were uncovered; they were in consequence condemned and taken out. On examination of them, I found the flues, the inner shells, flattened *directly underneath* the safety valve, but in every other part the form was retained. And the query has occurred to me, whether the opening of the safety valve, and shutting it suddenly, may not cause a reaction in the boiler, upon the principle of the hydraulic ram, and thus occasion the explosion. The metal, however, was so much injured by the heat as to become hard, flinty, and brittle, losing all its tenacity and malleability, and was supposed by experienced coppersmiths to be gun metal. I have also observed that wrought iron, in similar cases, undergoes a change, whereby it becomes like cast iron. The boilers being taken out, two others of wrought iron, of a cylinder form, with cylinder flues, were put in, and the boat put in operation. From the incrustation formed between the flues and boiler shells, or outer coats, and by letting the water get low, these boilers were injured and condemned also, although they were used but about three weeks.

"The steam-boat Legislator, (a boat which had a boiler exploded in the harbour of New York, by which several persons were injured,) plying between this port and Bath, in the state of Maine, having a low pressure, or condensing, engine, overheated her boiler in consequence of the forcing pump being out of order, whereby the water was not kept up. The oval or elliptical furnace flue was much flattened on the upper part, but before any explosion took place, the fire was extinguished, and the boiler got cool before water was forced in, or the boiler filled. I was informed by the agent who was on board at the time, that the *upper part* of the shell, or outer coat, of the boiler was afterwards discovered to have been heated to so great a degree as to burn a woollen jacket which was laying on it.

"I am of opinion that had the forcing pump been put in operation prior to cooling the boilers, the liability to an explosion would have been great. I afterwards repaired the boiler, and discovered the iron to be hard and brittle in those parts where it was much exposed to heat.

"As these are the only instances of extraordinary injuries to boilers which have come within my observation, you will perceive my information is very limited as to the subjects of your inquiry. My opinion is, that in every one of these cases, the injury might probably not have occurred, had a proper degree of attention been given

by those entrusted with the management of the machinery; at least, the injury did not arise from any defect of the materials.

"Presuming that much of the information which will be derived, as to the cause of explosions of steam boilers, will be matter of opinion, I will take the liberty of stating what has appeared to me as having been the cause of many of the explosions in the boilers on board of steam-boats in the waters of the United States. And first, to want of skill may be fairly attributed many of the accidents which have happened, whether attended with explosions or not. The introduction of steam navigation has been so rapid that men of character, capability, intelligence, skill, and sobriety, were difficult to be procured in sufficient numbers; and such, when employed, demanded liberal compensation for their services. The several owners, competitors in the various lines or routes, governed by a mistaken policy, rather than pay the wages demanded by competent and skilful engineers, have in many cases employed those as engineers whose whole knowledge consisted in understanding how to stop and start an engine; and as firemen, those whose only qualification was, that they could throw wood into the furnace. Hence, when any part of the machinery happened to be disordered, those entrusted with its management, being conscious of their want of science and skill, became incapable of applying the limited knowledge which they possessed, and injury and accident ensued.—Again, engineers and firemen on board of steam-boats have been, not unfrequently in times past, and I believe they are still, in some cases, at present, treated with intoxicating liquors by the passengers, and thereby rendered incompetent to manage the machinery."

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## (No. XVIII.)

Anonymous communication received from England, through P. Vaughan, Esq. of London.

Sir,—In consequence of a notice in the Mechanics' Magazine, I trouble you with this letter, and beg attention to the accompanying newspaper communication. I am of opinion that a boiler constructed with a safety plate, such as described, would not burst.

A boiler belonging to a colliery engine of mine has had such a plate on for several years, working at high pressure. A few months ago I directed the engine man to fasten down one of the ordinary safety valves, and overload the other, make a large fire under the boiler, and wait the event; he did so, and the result was the tearing asunder of the leaden plate with a loud explosion, without any damage whatever to the boiler or engine. The plate gradually thins and protrudes in the middle, and at last tears across, thus +, leaving four angular pieces standing up like spear heads.

Leaden plugs have been tried, to melt with hot steam, but this plan does not do, because it requires the steam always to be of a certain intensity before the lead can melt; whereas, an old boiler might burst

before the steam acquired such intensity. Now my plate need only be a few degrees stronger than working steam, whatever strength it be, and any thing beyond that will tear it and save the boiler.

If you have any wish, I will send the torn lead plate, and any communication will reach me through the hands of Mr. Mort, Newcastle, Staffordshire.

SAXULA.

*September* 8, 1830.

P. S. The efficacy of this plate is certainly such, that I think it cannot be too soon or too generally tried, previously to any extensive investigation, as I think it almost impossible to ascertain the particular causes of the bursting of many boilers, beyond the overstrength of steam; all moveable valves are liable to "gag," or stick in the sliding parts, from unforeseen, and often unknown causes. A lead plate cannot cease to act, unless a stronger be purposely screwed over it.

*To the Editor of the Staffordshire Advertiser.*

SIR,

"Govern these ventages with your finger and thumb."

SHAKSPEARE.

As I trust the time is fast approaching when we shall see carriages propelled by steam traversing our common roads in all directions,—but at what speed I dare not undertake to say: and as there is a very prevalent feeling of dislike to, or fear of their introduction, on account of apprehended dangers from explosion of the boilers, I have no doubt you will feel a pleasure in assisting to disperse as widely as possible, the following most simple and efficacious preventive from any such dreadful catastrophes.

Your readers may suppose the invention to have arisen out of the following familiar occurrence, which forms the strongest illustration that I can give of its principles and efficacy.

A narrow mouthed stone ware jar, filled with fruit, and closed by a bladder, was placed in a kettle of boiling water to stew. The sirop of the fruit soon became as hot as the water, and then steam began to form, which having no vent, at last burst the bladder and escaped. Now, had the bladder been as strong as the jar, the steam would have been confined until its strength became sufficient to burst the jar, and discharge at once its whole contents, the consequences of which may easily be imagined.

On the top of my boiler, in addition to the usual safety valves, I place a pipe of dimensions sufficient to discharge the steam gradually. The orifice of this pipe I cover with a plate of thin sheet lead, strong enough to hold steam of proper working strength. Now, should any cause obstruct or overload the safety valves, as soon as the steam becomes too strong, the sheet lead tears asunder and discharges it. It is impossible to burst the boiler. This, I believe, wants no science to make it plain, any one may understand it;—a

report will be heard, and the journey will be delayed, but no damage can ensue.

Even the "great steam chamber (A,) alias safety chamber, alias danger chamber," about which there was so much bickering a few months ago in the Mechanics' Magazine and the Register of Arts, will become with this appendage, quite harmless.

Such is the safety of this simple contrivance, that I think it would not be unworthy the notice of parliament, making it penal for a boiler to be found without it, at the same time regulating the size of the orifice, and thickness of the lead.

This security is attached to the boiler of my little steam carriage, the "Triumph," heretofore noticed in your columns; the pipe is one inch diameter, and the lead about the thickness of brown paper.

* * * * *

Yours,

*May* 5, 1830. SAXULA.

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(No. XIX.)

*To the members of the Franklin Institute.*

Since the frequent disasters occurring on board of steam-boats by the explosion of boilers, public attention has been aroused, and the executive of the nation called upon by the voice of the representatives of the people for information, and also your body have called upon engineers generally for information, as to the adoption of suitable means for the prevention of those accidents which have hurried into eternity hundreds of our most valuable and highly respected fellow citizens. It therefore behooves every engineer, however humble, and however unknown to the public, after being called upon by you, to give his views, that from the united opinions of engineers on this subject, something may be gleaned which may lessen those disasters, or entirely prevent their recurrence.

The undersigned, an humble individual of the profession, not known, or wishing to be, by writing on this subject, would respectfully lay his opinion before your more enlightened judgment.

In the first place I assert, without fear of contradiction, that two-thirds of the accidents, are to be attributed to nothing but ignorance; and from this cause, that men who are perfectly acquainted with their business cannot be had except at high wages; and through a mistaken notion of economy, a fireman is taken, who has gained the experience of stopping and starting an engine, but who is entirely ignorant of its principle; aye, some who could not tell you whether the engine they were attending was high or low pressure! And thus the grandest machine ever invented, and the lives of thousands, are placed in the hands of ignorance. No wonder that explosions occur!

Secondly. It is a general rule with engineers, on both land and water, with both high and low pressure engines, that the moment they

are stopped, the safety valve is raised, and the steam let off, which I think is entirely wrong, (although it is an old practice,) for these reasons, which I submit to your better judgment. It is a rule with engine builders, to make their boilers capable of resisting twice, thrice, or four times the pressure calculated to be borne upon them; and very often when a steam engine is in operation, we see the steam blowing off. And why, I would ask, is not a boiler as safe when the engine is not in operation? The disadvantage in blowing off steam, I conceive to be this, that the water in the boiler is lowering and passing away in steam; whereas, should the safety valve be left down, the steam by degrees would condense in the boiler, and very little water be lost in evaporation.

Thirdly. There should be some means adopted whereby the pressure carried on safety valves should be regulated, and not leave it to ignorance to place a greater weight thereon, perhaps for the purpose of outrunning an opposition boat, or under the influence of spirituous liquor.

Fourthly. Great care should be taken at all times to have a sufficient quantity of water in the boiler, for it is a well known fact, that if the water descends below the flues of the boiler, the fire immediately acts upon the iron or copper, and it is burned through before it is possible to supply it with water.

I would now take the liberty, after the foregoing remarks on this important subject, to recommend a remedy which I think, if adopted, would lessen, or, as I have said before, prevent the recurrence of steam-boat accidents, viz. that three engineers, theoretically and practically acquainted with the business, should be appointed in different central places on all our rivers, or where steam-boat navigation extends, whose duty it should be to examine the engineers employed on board of steam-boats, as to their practical and theoretical knowledge of engineering, and after such examination a diploma or certificate should be granted them if found proficient, and that there should be a penalty imposed upon the owners of any boat who should employ an engineer on board of their boat who had not a diploma signed by the examining engineers. And also that it should be the duty of said examining engineers, to examine every boiler and prove the same, either by steam or water, as may seem to them best, and condemn every boiler which should not bear four times as much pressure as is necessary on the safety valve when the engine is in operation, and this examination to be gone through once a year. Also to regulate the pressure to be carried on every boiler, and after such regulation a penalty should be incurred by the engineer should he, from any cause whatever, place more weight on the safety valve than the examining engineers had determined should be carried thereon.

A Practical Engineer.

*Philadelphia, November* 2, 1830.

(No. XX.)

*December* 1, 1830.

Sir,—I take the liberty of communicating to you my views of the causes of the explosions that so often take place in steam boilers, agreeably to the solicitations in the circular addressed to the public by your committee of the Franklin Institute appointed for that investigation. I do not pretend that my ideas are all new, but the treatises I have seen on steam, have given less attention to some of them, than I conceive due to a full understanding of the matter.

The explosions of steam boilers, it is believed, have been much more frequent on the waters of the Mississippi river than elsewhere, and even in greater proportion to the number of engines in use. The accounts given of these disasters, report them to have occurred at landing places, or at the first working of the engine after delays, as at wood yards or towns on the river. During these delays it is to be observed that the engine is stopped from working, and the water in the boilers is diminishing by evaporation, so that a considerable portion of them above the level of the water, is left to be heated to a temperature that will rapidly produce steam when the water may be disturbed and thrown in contact with it, and afford one material cause of the explosions which take place. And although the fires are not kept up during these delays, yet there is heat enough in the furnace to keep up a high temperature, and together with the firing up before starting, is sufficient to charge the fluids within the boilers to their highest capacity while in their quiescent state with caloric. Under these circumstances, the engine is to be put in motion; when the first evacuation of steam will necessarily give rise to an ebullition of the water in the boiler, and excite to activity the super charge of caloric in the water and steam within, which together with the cause above shown will give an explosive power that no steam boilers can resist: or, in other instances, the motion of the boat may aid or entirely produce the same effect on starting from a state of rest.

Such I conceive to be the cause of the greater part of the accidents that occur on the western waters. To remedy which, I would suggest that at all delays of more than ten or fifteen minutes, the engine should be thrown out of gear with the wheels, and kept in operation till cool; or in case of firing up again, the engine be worked till the boat should be ready to start. By these cautions the danger incident to the stopping of the engine will be obviated, the boilers will have their full supply of water, and the working of the engine will prevent the accumulation of caloric in a latent or inactive state in the water and steam they contain. That heated water will yield more steam when agitated than when at rest is certain, the increased evaporation caused by agitation at all temperature is well known; from which it appears, that caloric may pass into water in a latent form, and be made active again by mechanical means, and no doubt aids much to produce the effects here assigned to it.

There is another kind of explosion more violent and destructive than the above. These occur when the boilers are not supplied with

water, either from the failure of the pumps, or neglect of the engineer. In such cases, the first indication of the mischief is the failure of the engine to perform its work. As the water gets exhausted, the parts of the boiler above its level become heated, beyond what the steam can counteract, and soon will acquire a degree of heat to decompose steam. Here then are two causes counteracting each other: the water converting into steam in a decreasing ratio, and the heated boiler destroying it in an increasing one; from which it is evident there will be a time when the force of the engine will cease, and the water in the boiler no longer held under a pressure from the steam, will rise into foam, so as to come in contact with the whole interior surface of the heated boiler; which, from this contact, will change its temperature from decomposing the water, into that suitable to convert it into the most powerful steam. This change, it will be observed, is not instantaneous, to produce the most violent shock at first; the boiler will require some moments of time to pass through the change, and hence produce the most violent effect even after the breach may be made. This accounts, to my satisfaction at present, for the perplexing things observed in these strange accidents: such as the loss of steam, the breach, and the violent explosions that follow.

The evil to be corrected, on the above suggestions, is no longer to be sought for in the construction of the machines. The danger lies in the combined elements of fire and water, which in some intricate stages will not suffer our control. I have no doubt but the engines in general are, in every respect, suited to their purpose; and if managed with proper care and skill, may be used with the utmost safety; but without these the strongest made engine is as dangerous as the poorer ones. It is to the ignorance and carelessness of those who have charge of engines, that so many melancholy accidents from steam boilers are to be assigned. The greater part of the engineers and officers on board of steam-boats whom I have met with, I have found quite ignorant of the nature of the power they are using. The former generally acquire their responsible profession at the engine factories, or in the duties of firemen. It is not supposed, therefore, that they should be acquainted with the *science* of steam. I have even known those of the highest standing to be entirely ignorant of the principles of the common pump, and unable to correct the bad working of the machine but by repeated trials, during which the greatest mischief may arise. The officers of the boats are but too generally no better informed in the principles of mechanical forces, as well as of fluids, liquid and aeriform, by which all their operations are carried on.

The remedy to the foregoing evils will now suggest itself. The subject of steam and steam engines must be fully explained, and regularly taught, in our institutions and schools of science; and made the subject of lectures and instruction for the benefit of those engaged in it, particularly of those who are to have charge of and to work the engine. And, in fine, a state of things should be brought about, by which those who would wish to follow this profession, should be known by their testimonials to be men of steady habits, and possessing that kind of knowledge which fits them for the trust.

The cause of humanity requires of us to do away with the dangers so unnecessarily put upon our fellow beings, and while our scientific institutions are devoted to the advancement of the most useful instruction, let them all unite and diffuse, generally, that knowledge which is of the utmost importance for the safe and prosperous application of the greatest invention that has ever been made. Let steam be a subject of study and instruction in proportion to its value, and when once a thorough knowledge of it is circulated, we shall find that safety in it which is so much to be desired.

These ideas, if of any value, are humbly inscribed to the Franklin Institute, by G. W. I.

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## (No. XXI.)

Reply to a circular letter of the committee appointed at a meeting of the Board of Managers of the Franklin Institute, to inquire into the causes of the explosion of the boilers of steam engines.

*Louisville, August* 8, 1831.

Gentlemen,—Since I became a subscriber to the Journal, I have perused your circular letter inquiring into the causes of the explosions of the boilers of steam engines, and it afforded me much pleasure to see the interest which you have manifested in ascertaining the causes of these melancholy accidents, and devising some plan by which they may be avoided. The numerous explosions which have taken place within the last two years, are alarming, and are almost sufficient to deter a person from travelling in a steam-boat. I am induced to believe, from observation and experience, with yourselves, "that those explosions were produced rather by imperfection in the construction, arrangement, and management of the machinery, than by any inherent and irremediable source of danger in the invention itself." There are now many men engaged and engaging in the engineering business, through the influence of their friends and relatives, who are interested in boats, who are not mechanics of any description; they learn, in a short time, how to start and stop an engine, but know nothing about the first or constituent principles of the machinery, or the construction of it; they know but little about the dangerous properties of steam under some circumstances; they are unable to understand the different effects which occur about an engine; they are ignorant of the pressure which boilers of different sizes and thicknesses are able to sustain; consequently the safety valve is frequently overloaded at the risk of the lives of three or four hundred passengers. It is unquestionably evident, beyond the possibility of doubt, that no man can be capable of doing justice as an engineer who is entirely ignorant, both of the theory and practice of mechanics; (as well might a man attempt the practice of medicine without a knowledge of anatomy;) and so long as men of this kind are employed in boats, so long will accidents occur, in which many valuable individuals will be blown to eternity, leaving in many cases destitute wives and children to lament their untimely death. Humanity calls

aloud for some measure to be taken, to prevent, if possible, these explosions, particularly when we reflect that within the last two years, upwards of one hundred persons, on the Ohio and Mississippi rivers, have fallen victims to the mismanagement of that powerful agent, steam. The subject of explosions is one that has engaged my attention for some time, and I have been collecting all the information I could from some of these accidents, of which I shall proceed to give you an account, agreeably to your request. I have endeavoured to collect the facts as correctly as possible, though in some instances it was difficult to arrive at the truth; for some engineers who were on board at the time of these accidents, and who escaped unhurt, are unwilling to acknowledge that any thing was going wrong at the time of an explosion; so, in some instances, I have relied more upon the information I obtained from passengers. In giving a description of these explosions, I will add my opinion of the causes, according to Mr. Perkins's theory, which I believe to be very applicable.

*The boiler of the steam-boat Atlas*, which was built for towing vessels, burst on the 1st day of April 1828, at the mouth of the Mississippi. She came to alongside of a vessel to tow it up to New Orleans, and as soon as they had made fast, they rang the bell to go ahead. The first engineer started her, and after she had made two or three revolutions, one of the boiler heads blew out at the after end; the second engineer was the only person killed. The steam may have been higher than the engineer was aware of, but it seems that the principal cause of this accident was that the boiler head was not sound; it was of cast iron, and upon examination they found many small holes in the internal part of the head; and in addition to this, the head was only about one inch thick, which was much too thin.

*The Car of Commerce* was the next boat the boiler of which burst. On the 15th of May, 1828, as she was on her way from New Orleans to Louisville, and had got up the Mississippi as far as the Canadian reach, her force pump became heated, and refused to supply the boilers. The engineer stopped her a few minutes to cool down the force pump, and then started her again; but still the pump refused to supply the boilers; they then stopped a second time to examine the pumps, and after a few minutes delay, they started her again, but the engine had not made more than two or three revolutions before the after head of one of her boilers blew out, and killed twenty-six persons, including three engineers. When the head blew out, the reaction of the atmosphere was so great that her boilers, four in number, jumped forward and fell upon the deck. Unfortunately it seems that this boiler head had been cast from the same pattern which had been used for the Atlas. The engineers were apprized of its being cracked previous to the explosion; but, independently of this, there can be no doubt that the water was low in the boilers, as the force pump had failed, and the engineer perhaps neglected to have the fires sufficiently damped, which I know to be frequently the case when an engine is stopped, while under way, to repair something which it is supposed will occasion but a few minutes delay. In the case of

the Car of Commerce, it is generally believed that the water had sunk below the top of the flues in the boilers, which became then exposed to the action of the fire. The steam exposed to the influence of those flues which were most probably red hot, became intensely heated, though of little elastic force; the throttle valve was opened at this time; a discharge of steam followed; the water which before was quiet, being suddenly relieved from the pressure upon its surface, rising up in contact with the heated flues and steam, was instantly converted into vapour, whose elastic force was so great as to produce an explosion.

*The boiler of the tow-boat Grampus* exploded on the 11th of August, 1828, about eight miles below New Orleans. She was bound up, with two or three vessels in tow at the time when this occurred, which was in the night. The second engineer, who had been placed on watch, had gone to sleep; when he awoke, he found that the water had sunk below the lower gauge cocks, and it is thought that he immediately let on a full supply from the force pump. One person on board noticed his being alarmed when the gauge cocks indicated no sign of water, and shortly afterwards the explosion took place. She had eight double flue boilers, which were all blown overboard, except two pieces of boiler, one about six feet square, and the other about four; besides there were three or four flues remaining on deck, some of which were partly collapsed. Nine persons were killed, including the second engineer; and the damage of the boat was estimated at eight thousand dollars. In this case, the boilers must have been nearly dry, and the flues red hot; and in this situation the engineer it seems let on as much water as the force pump could throw. According to Mr. Perkins's theory, the water, in entering the boiler, was instantaneously flashed into steam of great elasticity, and as the strength of the boilers was much diminished in consequence of their being heated to a very high temperature, it did not require much elastic force to tear them asunder.

*A flue of the steam-boat Patriot* collapsed in the spring of 1828, near the mouth of the Ohio, on her way from Louisville to New Orleans. The second engineer was on watch, and neglected his business so far as to let the water sink below the flues. In this situation he kept the engine going without having the fires damped, until a flue collapsed and killed two persons. This accident was entirely owing to the sinking of the water below the top of the flue, which was exposed to the fire on the inside, and which, being unprotected by water on the outside, soon became red hot; consequently, its strength was so far diminished that the pressure of the steam, within the boiler, forced its sides together.

One of the boilers of the *Kenhawa Packet* burst on the 27th of June, 1829, at Guyandot, on the Ohio river. In giving a description of this accident, I have relied on the information I obtained from an engineer who was a passenger on board the boat. They landed to put out some passengers, and expected to start again in a few minutes, but were detained above half an hour. The engineer probably thought that the water was flush enough in the boilers, as he did not run the

engine out of gear, which is always done immediately after upon making a landing, in order to keep a supply of water in the boilers. When they shoved out from shore, the engineer found the water had sunk below the gauge cocks, and he appeared to be a little alarmed, as the steam was very high. After they had shoved out from shore, and before they could start, a passenger had to be sent ashore in the yawl, which occasioned further delay, and just as the engineer was going to start the engine, one of her boilers burst and killed eight persons, including the two engineers. I examined this boiler myself; both heads were blown out; they were of cast iron: the flue was separated about the middle, and the forward end of it was thrown overboard; the boiler was torn in a spiral form about half its length, and spread out nearly to a plane surface. This I think was a case similar to that of the Car of Commerce, and especially produced by the opening of the safety valve, which occasioned the water to rise in contact with the heated flues and steam. I know it to be a fact, from experience, that water will rise up in a boiler when the safety valve is opened, for not long since, as I was running an engine, finding that the force pump refused to supply the boilers, I immediately stopped and damped the fire, and upon examination I found that the water had sunk below the lower gauge cocks, which are generally situated about two inches above the flues, in the end of the boiler. By hoisting the safety valve for a few seconds, I found that the water rose up flush with the gauge cocks, and by closing the valve the water again sunk.

*A flue of the steam-boat Huntress* collapsed on the 11th of April, 1830, near Golconda, on the Ohio river; four persons were killed, including the first engineer, who was on watch at the time. The boat was stopped to send the yawl ashore with a passenger, during which time the engineer blew off steam occasionally, and when the yawl returned, he started the engine, though it did not make more than two or three revolutions before one of the flues collapsed. It was the general opinion on board that the water was low in the boilers; so this accident may be accounted for upon the same principles as that of the Patriot. This accident, and many others of the same kind, might have been prevented if they had stopped in time, and damped the fires; but it is a melancholy fact, that many engineers are ignorant of the rapid evaporation which is going on in boilers when an engine is stopped and the fires burning lively; they are not sensible of the liability to danger under these circumstances.

A boiler of the *steam-boat Caledonia* blew up a few days after that of the Huntress, and killed between twenty and thirty persons. She was on her way from New Orleans to Louisville, and had ascended the Mississippi up to New Madrid. This explosion took place while the boat was under way, and it was immediately reported that every thing was in order at the time, that the water was flush in the boilers, and the steam not very high; but I have conversed with several passengers who were on board, two in particular, who told me they were willing to make oath that they saw the first engineer, who was on watch, try the gauge cocks, and that there was not a particle of water

to be seen, and that the steam was very high; that the engineer appeared to be alarmed, and that they anticipated danger themselves, and left the engine room, but had scarcely got on the upper deck when the boiler burst. It appears that a good deal of mud had collected in her boilers, as the engineers had some trouble for a day or two previous in keeping up a supply of water. The mud from the Mississippi water collects in boilers very fast, and sometimes stops up the connexions between some of the boilers, so that water may be seen flush in some of them, when it is below the gauge cocks in others. I examined the Caledonia's boiler after she was towed up to Cincinnati; it burst near the bottom, close to the forward end, though neither of her heads was blown out. The boiler was torn open about half way around, in the direction of the rivets in some places, and across the sheets in others. This boiler had been repaired a few months before in the very place that gave way, and copper rivets were used instead of iron; this was one of the principal causes of the explosion, for copper will sustain but little more than half the pressure that wrought iron will.

At the place that gave way in this boiler, the iron was burned until it was but little more than an eighth of an inch thick, which was not much more than half its original thickness. When boilers are suffered to get very muddy, the sediment collects in the bottom, until a crust or scale of the carbonate of lime is formed, which soon becomes so hard as to be impenetrable to water; consequently, the boiler will be burned when it is not directly protected by water on the inside. It has frequently happened that holes were burned in boilers by the fireman's accidentally leaving a piece of apron or broom inside when they were cleaning them out; and I have known boilers to be burned until they were scarcely a sixteenth of an inch thick at the bottom, while they retained a thickness of a quarter of an inch at the top; though I do not think this would ever occur with proper attention.

A boiler of the *Helen M'Gregor* burst on the 24th of February, 1830, at Memphis, on the Mississippi, as she was bound up the river. The boat had landed to put out some freight, and just as they had shoved out to go ahead again, one of her boilers burst before the engineer had started her. It is not known how many persons were killed, but somewhere between thirty and forty. It was the after head of one of her boilers that blew out; it was of cast iron, and had been cracked two or three years, and it jumped out of its place from the others about one hundred yards into the river. The principal cause of this accident I suppose was that the boiler head was cracked, a circumstance of which the engineers were apprized, and they ought not to have trusted it; in addition to this, the steam was very high at the time the explosion took place.

A boiler of the *steam-boat Tri-Colour* burst last April at Wheeling, on the Ohio river, and killed thirteen persons, including the captain and second engineer. The first engineer, who escaped unhurt, has given me, I believe, a correct account of this explosion. He states that he was on watch when the boat landed, and that he ran

up the water flush in the boiler, and had the fires damped down before he stopped the engine, as they were going to lie there long enough to make some repairs to the boat. He went into the hold to give a smith directions about making some bolts, and then came out and went to his breakfast, but before he had quite finished, the captain came to the door and observed that the steam was up, and he wished to start. The engineer immediately rose from the table, went out, and found that the steam was very high, and the fires burning lively, and before the bell rung to go ahead, the boiler burst. The captain had ordered the fireman to kindle up the fires, without ever giving the engineer any warning, so that this accident was owing principally to the imprudent conduct of the captain; and it is too often the case that captains interfere when they should not, and affect to know more about the engine, than those who have the management of its mighty power.

This was a low pressure boat, and all the others which I have spoken of were high pressure. The engineer told me he had been blowing off steam just before the boiler burst, and he thinks probably from the length of time which the fires had been burning without his knowledge, that the water had sunk below the flues. There was but one boiler in this boat; it was made after the old plan, with the furnace inside, and the place that gave way was inside of the furnace, directly over the fire grates. This boiler had been in use about ten years, and if many other boilers now in use, nearly of the same age, on the western rivers, could be subjected to the proof which the law requires at present in France, they would be condemned before they occasioned the loss of many lives; and I anticipate with pleasure the arrival of that time, which I hope is not far distant, when Congress will take up this subject again, and pay that attention to it which humanity calls for.

Four accidents have occurred within the last month, where flues were collapsed, and twelve or thirteen persons killed; and they were entirely owing to negligence or ignorance on the part of the engineer. I could enumerate more of these melancholy accidents, but as I have already transcended the limits of a letter, and probably imposed on your patience, I will desist.

It has been urged by some persons here, who are not acquainted with this subject, that some of these explosions could not have been prevented, because there was an old experienced engineer on board; but it requires no argument to prove that it is not length of time that makes a man more capable; for nature has not endowed every man with the same mechanical ingenuity and intellectual capacity. Many persons are engaged during their lifetime, at some mechanical business and never attain to mediocrity; I know some men who have been engaged for eight or ten years at the engineering business, and who do not know near as much about steam and working machinery as some who have not been at it more than three or four years. You have enquired first "What are the probable causes of the explosion of boilers on board of steam-boats?" I have endeavoured to answer this inquiry in giving a description of some of these explosions. You

have inquired in the second place, "What are the best means to obviate the recurrence of these evils, or to diminish the extent of their injurious influence, if they cannot be wholly guarded against?" In answer to this inquiry I would say, in order to prevent these evils, adopt such a plan as the royal ordinance of France prescribes in relation to boilers. Further, cast-iron boiler heads should certainly be prohibited from use, as experience has proved them to be dangerous; and then the most essential thing, is to have a good engineer, for there can be no security in the use of even the strongest and best constructed boiler, if it be left to the management of a man who is ignorant of his duty, or of the strength of the engine. In the third place, you inquire, "By what means can these remedies be applied and enforced?" I shall answer this inquiry by saying, that I believe Congress have it in their power to enforce the means. You have asked for information relative to the boiler, safety valve, supply of water, and so forth. I am not able to give the exact dimensions of the boilers that burst, though I may give them approximatively.

Boilers here are of wrought iron, (none of copper,) made from thirty-two to forty-two inches in diameter, and from three-sixteenths of an inch to one-quarter of an inch thick, some of foreign, and some of American iron; and the difference in the strength of the two is but trifling when they are both well manufactured. The safety valves are from three to five inches in diameter, situated on top of the boilers, loaded with from eighty to one hundred and twenty-five pounds to the square inch; and sometimes considerably more no doubt, as there is scarcely one engineer in twenty that can make a calculation of a safety valve. The generality of boats have but one safety valve, some have two; the Caledonia had four. A safety valve has no more tendency to prevent an explosion under some circumstances, particularly when the water gets low in the boilers, and steam high, than the touch hole of a gun has to prevent the barrel from bursting. When steam gets extremely high, and water low, the safety valve should not be opened, as is so frequently done, instead of damping down the fires. The mode of supplying the boilers with water is with one, and sometimes two, force pumps, which with proper attention I believe to be a good arrangement.

In concluding this letter, permit me to acknowledge my inability to do justice to the subject, and if any thing that I have said should merit your attention, I shall think it an ample recompense for my trouble.

THOS. J. HALDERMAN.

[TO BE CONTINUED.]

(Continued from p. 373, vol. viii.)

TABLE N.—PART I.

CHUTE No. 6.—*Elbow buckets. Close breast. Bottom of gate* 3.66 *feet above bottom of wheel.*

| No. of Exper't. | Head of Water above. Bttm. of gate. Feet. | Top of Bkt. Feet. | Btm. of Bkt. Feet. | Width of Aperture. In. | Weight raised. Pds. | Friction. Pounds | Sum of friction and weight raised. Pounds. | Height raised. Feet. | Time. Scds. | Velocity per second. Feet. | W't of water expended. Pds. | Head and fall. Feet. | Power. | Effect. | Ratio, power being 1. | Maximum effect. | Velocity at maximum. | Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 16.59 | 17.65 | 18.25 | 1.00 | 566 | 48.95 | 614.95 | 41.5 | 32 | 12.20 | 4500 | 20.75 | 933750 | 255204 | .273 | | | |
| 2 | | | | | 669 | 50.58 | 719.58 | | 37 | 10.56 | 5050 | | 1047875 | 298624 | .283 | | | |
| 3 | | | | | 772 | 52.21 | 824.21 | | 39 | 10.02 | 5775 | | 1198312 | 342046 | .285 | .285 | 10.02 | |
| 4 | | | | | 875 | 53.84 | 928.84 | | 45 | 8.71 | 6700 | | 1390250 | 385468 | .275 | | | |
| 5 | 16.59 | 17.65 | 18.25 | 1.25 | 566 | 48.95 | 614.95 | 41.5 | 26 | 15.04 | 4900 | 20.75 | 1016750 | 255204 | .250 | | | |
| 6 | | | | | 669 | 50.58 | 719.58 | | 28 | 13.96 | 5300 | | 1099750 | 298624 | .271 | | | |
| 7 | | | | | 772 | 52.21 | 824.21 | | 32 | 12.20 | 5750 | | 1193125 | 342046 | .286 | | | |
| 8 | | | | | 875 | 53.84 | 928.84 | | 34 | 11.50 | 6325 | | 1312437 | 385468 | .293 | } .293 | 11.50 | |
| 9 | | | | | 978 | 55.47 | 1033.47 | | 37 | 10.56 | 7025 | | 1457687 | 428889 | .293 | | 10.56 | |
| 10 | | | | | 1081 | 57.10 | 1138.10 | | 45 | 8.71 | 8475 | | 1758562 | 472310 | .267 | | | |
| 11 | 13.59 | 14.65 | 15.25 | 0.75 | 416 | 46.59 | 462.59 | 41.5 | 37 | 10.56 | 3730 | 17.75 | 662075 | 191974 | .289 | | | |
| 12 | | | | | 463 | 47.32 | 510.32 | | 41 | 9.54 | 4050 | | 718875 | 211782 | .294 | .294 | 9.54 | |
| 13 | | | | | 519 | 48.21 | 567.21 | | 47 | 8.32 | 4525 | | 803175 | 235392 | .293 | | | |
| 14 | 13.59 | 14.65 | 15.25 | 1.00 | 566 | 48.95 | 614.95 | 41.5 | 34 | 11.50 | 4825 | 17.75 | 856437 | 255204 | .298 | | | |
| 15 | | | | | 669 | 50.58 | 719.58 | | 39 | 10.02 | 5425 | | 962937 | 298624 | .300 | .300 | 10.02 | |
| 16 | | | | | 772 | 52.21 | 824.21 | | 45 | 8.71 | 6450 | | 1144875 | 342046 | .298 | | | |
| 17 | 13.59 | 14.65 | 15.25 | 1.25 | 669 | 50.58 | 719.58 | 41.5 | 30 | 13.02 | 5675 | 17.75 | 1007312 | 298624 | .296 | | | |
| 18 | | | | | 772 | 52.21 | 824.21 | | 34 | 11.50 | 6200 | | 1100500 | 342046 | .310 | | | |
| 19 | | | | | 875 | 53.84 | 928.84 | | 38 | 10.28 | 6950 | | 1233625 | 385468 | .312 | .312 | 10.28 | |
| 20 | | | | | 978 | 55.47 | 1033.47 | | 42 | 9.31 | 8350 | | 1482125 | 428889 | .289 | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | |

TABLE N.—PART II.

CHUTE No. 6.—*Elbow buckets. Close breast. Bottom of gate 3.66 feet above bottom of wheel.*

| No. of Exper't. | Head of water above. Btm. of gate. | Head of water above. Top of bkt. | Head of water above. Btm of bkt. | Width of Aperture. | Weight raised. | Friction. | Sum of friction and weight raised. | Height raised. | Time. | Velocity per second. | W't of water expended. | Head and fall. | Power. | Effect. | Ratio, power being 1. | Maximum effect. | Velocity at maximum. | Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Feet. | Feet. | Feet. | In. | Pds. | Pounds | Pounds. | Feet. | Scds. | Feet. | 'Pds. | Feet. | | | | | | |
| 21 | 10.59 | 11.65 | 12.25 | 0.75 | 360 | 45.69 | 405.69 | 41.5 | 38 | 10.28 | 3725 | 14.75 | 549437 | 168361 | .306 | | | |
| 22 | | | | | 416 | 46.59 | 462.59 | | 41 | 9.54 | 4040 | | 595900 | 191974 | .332 | .332 | 9.54 | |
| 23 | | | | | 463 | 47.32 | 510.32 | | 46 | 8.50 | 4500 | | 663750 | 211782 | .303 | | | |
| 24 | 10.59 | 11.65 | 12.25 | 1.00 | 463 | 47.32 | 510.32 | 41.5 | 34 | 11.50 | 4740 | 14.75 | 699150 | 211782 | .302 | | | |
| 25 | | | | | 566 | 48.95 | 614.95 | | 39 | 10.02 | 5280 | | 778800 | 255204 | .328 | .328 | 10.02 | |
| 26 | | | | | 669 | 50.58 | 719.58 | | 46 | 8.50 | 6200 | | 914500 | 298624 | .326 | | | |
| 27 | 10.59 | 11.65 | 12.25 | 1.25 | 566 | 48.95 | 614.95 | 41.5 | 32 | 12.20 | 5625 | 14.75 | 829687 | 255204 | .307 | | | |
| 28 | | | | | 669 | 50.58 | 719.58 | | 37 | 10.56 | 6150 | | 907125 | 298624 | .329 | .329 | 10.56 | |
| 29 | | | | | 772 | 52.21 | 824.21 | | 39 | 10.02 | 7050 | | 1039875 | 342046 | .328 | | | |
| 30 | | | | | 875 | 53.84 | 928.84 | | 45 | 8.71 | 8035 | | 1185262 | 385468 | .325 | | | |
| 31 | 7.84 | 8.90 | 9.50 | 1.00 | 463 | 47.32 | 510.32 | 41.5 | 38 | 10.28 | 5175 | 12.00 | 621000 | 211782 | .340 | | | |
| 32 | | | | | 566 | 48.95 | 614.95 | | 44 | 8.88 | 5925 | | 711000 | 255204 | .357 | .357 | 8.88 | |
| 33 | | | | | 669 | 50.58 | 709.58 | | 56 | 6.98 | 7225 | | 867000 | 298624 | .344 | | | Head sunk four inches. |
| 34 | 7.84 | 8.90 | 9.50 | 1.25 | 463 | 47.32 | 510.32 | 41.5 | 34 | 11.50 | 5625 | 12.00 | 675000 | 211782 | .313 | | | |
| 35 | | | | | 566 | 48.95 | 614.95 | | 38 | 10.28 | 6150 | | 738000 | 255204 | .345 | .345 | 10.28 | |
| 36 | | | | | 875 | 53.84 | 928.84 | | 57 | 6.86 | 9325 | | 1119000 | 385468 | .344 | | | |
| 37 | | | | | 978 | 55.47 | 1033.47 | | 65 | 6.00 | 10800 | | 1296000 | 428889 | .330 | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | |

## Table N.—Part III.

**Chute No. 6.—*Elbow buckets. Close breast. Bottom of gate 3.66 feet above bottom of wheel.***

| No. of Exper't. | Head of water above. Btm. of gate. | Head of water above. Top of bkt. | Head of water above. Btm. of bkt. | Width of Aperture. | Weight raised. | Friction. | Sum of friction and weight raised. | Height raised. | Time. | Velocity per second. | Wt of water expended. | Head and fall. | Power. | Effect. | Ratio, power being 1. | Maximum effect. | Velocity at maximum. | Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Feet. | Feet. | Feet. | In. | Pds. | Pounds | Pounds. | Feet. | Scds. | Feet. | Pds. | Feet. | | | | | | |
| 38 | 4.34 | 5.40 | 6.00 | 1.50 | 566 | 48.95 | 614.95 | 41.5 | 44 | 8.88 | 7625 | 8.00 | 610000 | 255204 | .418 | | | |
| 39 | | | | | 669 | 50.58 | 719.58 | | 50 | 7.82 | 8750 | | 700000 | 298624 | .426 | .426 | 7.82 | |
| 40 | | | | | 772 | 52.21 | 824.21 | | 58 | 6.73 | 10100 | | 808000 | 342046 | .419 | | | |
| 41 | 4.34 | 5.40 | 6.00 | 1.75 | 566 | 48.95 | 614.95 | 41.5 | 40 | 9.77 | 7425 | 8.00 | 594000 | 255204 | .429 | | | |
| 42 | | | | | 669 | 50.58 | 719.58 | | 45 | 8.71 | 8290 | | 663200 | 298624 | .450 | .450 | 8.71 | |
| 43 | | | | | 725 | 51.45 | 776.45 | | 49 | 7.98 | 8975 | | 718000 | 322226 | .448 | | | |
| 44 | | | | | 772 | 52.21 | 824.21 | | 52 | 7.52 | 9525 | | 762000 | 342046 | .448 | | | |
| 45 | | | | | 828 | 53.02 | 881.02 | | 55 | 7.10 | 10325 | | 826000 | 365623 | .442 | | | |
| 46 | 1.00 | 2.06 | 2.66 | 1.50 | 360 | 46.61 | 406.61 | 41.5 | 63 | 6.20 | 6760 | 4.66 | 315692 | 168743 | .531 | | | |
| 47 | | | | | 416 | 47.62 | 463.62 | | 75 | 4.30 | 7500 | | 350250 | 192402 | .548 | .548 | 4.30 | |
| 48 | | | | | 463 | 48.48 | 511.48 | | 79 | 4.95 | 8370 | | 390879 | 212264 | .541 | | | |
| 49 | 1.00 | 2.06 | 2.66 | 1.75 | 360 | 46.61 | 406.61 | 41.5 | 61 | 6.40 | 6750 | 4.66 | 315225 | 168743 | .531 | | | |
| 50 | | | | | 463 | 48.48 | 511.48 | | 73 | 5.35 | 8160 | | 381072 | 212264 | .555 | .555 | 5.35 | |
| 51 | | | | | 519 | 49.31 | 568.31 | | 81 | 4.83 | 9100 | | 424970 | 235847 | .553 | | | |
| 52 | | | | | 566 | 50.35 | 616.35 | | 89 | 4.40 | 9925 | | 463497 | 255785 | .554 | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | |

## Table O.—Part I.

**Chute No. 6.**—*Centre buckets. Close breast. Bottom of gate 3.66 feet above bottom of wheel.*

| No. of Expt. | Head of water above. | | | Width of Aperture. | Weight raised. | Friction. | Sum of friction and weight raised. | Height raised. | Time. | Velocity per second. | Wof water expended. | Head and fall. | Power. | Effect. | Ratio, power being 1. | Maximum effect. | Velocity at maximum. | Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Btm. of ate. | Top of bkt. | Btm. of bkt. | | | | | | | | | | | | | | | |
| | Feet. | Feet. | Feet. | In. | Pds. | Pds. | Pounds. | Feet. | Scds. | Feet. | Pds. | Feet. | | | | | | |
| 1 | 19.34 | 20.40 | 20.40 | 1.00 | 463 | 47.32 | 510.32 | 41.5 | 33 | 11.84 | 3930 | 23.00 | 903900 | 211782 | .233 | | | |
| 2 | | | | | 566 | 48.95 | 614.95 | | 36 | 10.86 | 4450 | | 1023500 | 255204 | .249 | | | |
| 3 | | | | | 669 | 50.58 | 719.58 | | 40 | 9.77 | 5150 | | 1184500 | 298624 | .252 | .252 | 9.97 | |
| 4 | 19.34 | 20.40 | 20.40 | 1.25 | 463 | 47.32 | 510.32 | 41.5 | 25 | 15.64 | 4425 | 23.00 | 1017750 | 211782 | .207 | | | |
| 5 | | | | | 566 | 48.95 | 614.95 | | 27 | 14.48 | 4700 | | 1081000 | 255204 | .236 | | | |
| 6 | | | | | 669 | 50.58 | 719.58 | | 30 | 13.00 | 5250 | | 1207500 | 298624 | .247 | | | |
| 7 | | | | | 772 | 52.21 | 824.21 | | 34 | 11.50 | 5850 | | 1345500 | 342046 | .254 | .254 | 11.50 | |
| 8 | | | | | 875 | 53.84 | 928.84 | | 42 | 9.31 | 7000 | | 1610000 | 385468 | .239 | | | |
| 9 | 16.59 | 17.65 | 17.65 | 0.75 | 360 | 45.69 | 405.69 | 41.5 | 37 | 10.56 | 3225 | 20.75 | 669187 | 168361 | .251 | | | |
| 10 | | | | | 463 | 47.32 | 510.32 | | 49 | 7.98 | 3950 | | 819625 | 211782 | .254 | | | |
| 11 | | | | | 566 | 48.95 | 614.95 | | 60 | 6.50 | 5250 | | 931875 | 255204 | .273 | .273 | 6.50 | |
| 12 | 16.59 | 17.65 | 17.65 | 1.00 | 360 | 45.69 | 405.69 | 41.5 | 25 | 15.64 | 3675 | 20.75 | 762562 | 168361 | .223 | | | |
| 13 | | | | | 463 | 47.32 | 510.32 | | 29 | 13.48 | 4050 | | 840375 | 211782 | .252 | | | |
| 14 | | | | | 566 | 48.95 | 614.95 | | 33 | 11.84 | 4550 | | 944125 | 255204 | .270 | | | |
| 15 | | | | | 669 | 50.58 | 719.58 | | 37 | 10.56 | 5175 | | 1073812 | 298624 | .278 | .278 | 10.56 | |
| 16 | | | | | 772 | 52.21 | 824.21 | | 43 | 9.09 | 6050 | | 1255375 | 342046 | .272 | | | |
| 17 | | | | | 875 | 53.84 | 928.84 | | 54 | 7.24 | 7625 | | 1582187 | 385468 | .243 | | | |
| 18 | 16.59 | 17.65 | 17.65 | 1.25 | 772 | 52.21 | 824.21 | 41.5 | 32 | 12.20 | 6050 | 20.75 | 1255375 | 342046 | .272 | | | |
| 19 | | | | | 875 | 53.84 | 928.84 | | 36 | 10.86 | 6750 | | 1400625 | 385468 | .275 | .275 | 10.86 | |
| 20 | | | | | 978 | 55.47 | 1033.47 | | 42 | 9.31 | 7950 | | 1649625 | 428889 | .259 | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | |

## Table O.—Part II.

Chute No. 6.—*Centre buckets. Close breast. Bottom of gate* 3.66 *feet above bottom of wheel.*

| No. of Exper't. | Head of water above. Btm. of gate. | Head of water above. Top of bkt. | Head of water above. Btm. of bkt. | Width of Aperture. | Weight raised. | Friction. | Sum of friction and weight raised. | Height raised. | Time. | Velocity per second. | Wt of water expended. | Head and fall. | Power. | Effect. | Ratio, power being 1. | Maximum effect. | Velocity at maximum. | Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Feet. | Feet. | Feet. | In. | Pds. | Pds. | Pounds. | Feet. | Scds. | Feet. | Pds. | Feet. | | | | | | |
| 21 | 13.59 | 14.65 | 14.65 | 0.75 | 257 | 44.06 | 301.06 | 41.5 | 30 | 13.00 | 2980 | 17.75 | 514750 | 124940 | .242 | | | |
| 22 | | | | | 360 | 45.69 | 405.69 | | 36 | 10.86 | 3430 | | 608825 | 168361 | .276 | | | |
| 23 | | | | | 463 | 47.32 | 510.32 | | 43 | 9.09 | 4130 | | 733075 | 211782 | .288 | .288 | 9.09 | |
| 24 | | | | | 566 | 48.95 | 614.95 | | 55 | 7.10 | 5175 | | 918562 | 255204 | .277 | | | |
| 25 | 13.59 | 14.65 | 14.65 | 1.00 | 463 | 47.32 | 510.32 | 41.5 | 30 | 13.00 | 4410 | 17.75 | 782775 | 211782 | .270 | | | |
| 26 | | | | | 566 | 48.95 | 614.95 | | 33 | 11.84 | 4900 | | 869750 | 255204 | .293 | | | |
| 27 | | | | | 669 | 50.58 | 719.58 | | 38 | 10.28 | 5525 | | 980687 | 298624 | .304 | .304 | 10.28 | |
| 28 | | | | | 772 | 52.21 | 824.21 | | 44 | 8.88 | 6450 | | 1144875 | 342046 | .298 | | | |
| 29 | 10.59 | 11.65 | 11.65 | 1.00 | 360 | 45.69 | 405.69 | 41.5 | 30 | 13.00 | 4150 | 14.75 | 612175 | 168361 | .275 | | | |
| 30 | | | | | 463 | 47.32 | 510.32 | | 34 | 11.50 | 4780 | | 705050 | 211782 | .300 | | | |
| 31 | | | | | 566 | 48.95 | 614.95 | | 37 | 10.56 | 5325 | | 785437 | 255204 | .325 | | | |
| 32 | | | | | 669 | 50.58 | 719.58 | | 43 | 9.09 | 6175 | | 910812 | 298624 | .327 | .327 | 9.09 | |
| 33 | | | | | 772 | 52.21 | 824.21 | | 56 | 6.98 | 8100 | | 1194750 | 342046 | .287 | | | |
| 34 | 10.59 | 11.65 | 11.65 | 1.25 | 669 | 50.58 | 719.58 | 41.5 | 34 | 11.50 | 6650 | 14.75 | 980875 | 298624 | .304 | | | |
| 35 | | | | | 772 | 52.21 | 824.21 | | 40 | 9.77 | 7325 | | 1080437 | 342046 | .316 | .316 | 9.77 | |
| 36 | | | | | 875 | 53.84 | 928.84 | | 45 | 8.70 | 8675 | | 1279562 | 385468 | .301 | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | |

## Table O.—Part III.

**Chute No. 6.—*Centre buckets. Close breast. Bottom of gate 3.66 feet above bottom of wheel.***

| No. of Exper't. | Head of water above. Bttm. of gate. | Head of water above. Top of bkt. | Head of water above. Bttm. of bkt. | Width of Aperture | Weight raised. | Friction. | Sum of friction and weight raised. | Height raised. | Time. | Velocity per second. | Wt of water expended. | Head and fall. | Power. | Effect. | Ratio, power being 1. | Maximum effect. | Velocity at maximum. | Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Feet. | Feet. | Feet | In. | Pds. | Pounds | Pounds. | Feet. | Scds. | Feet. | Pds. | Feet. | | | | | | |
| 37 | 8.34 | 9.40 | 9.40 | 1.00 | 360 | 45.69 | 405.69 | 41.5 | 35 | 11.16 | 4375 | 12.00 | 549000 | 168361 | .306 | | | |
| 38 | | | | | 463 | 47.32 | 510.32 | | 39 | 10.02 | 5170 | | 620400 | 211782 | .341 | | | |
| 39 | | | | | 566 | 48.95 | 614.95 | | 45 | 8.70 | 6090 | | 730800 | 255204 | .349 | .349 | 8.70 | |
| 40 | 8.34 | 9.40 | 9.40 | 1.25 | 463 | 47.32 | 510.32 | 41.5 | 33 | 11.84 | 5875 | 12.00 | 705000 | 211782 | .300 | | | |
| 41 | | | | | 566 | 48.95 | 614.95 | | 37 | 10.56 | 6450 | | 774000 | 255204 | .329 | | | |
| 42 | | | | | 669 | 50.58 | 719.58 | | 41 | 9.54 | 7300 | | 876000 | 298624 | .340 | .340 | 9.54 | |
| 43 | | | | | 772 | 52.21 | 824.21 | | 50 | 7.82 | 9330 | | 1119600 | 342046 | .305 | | | |
| 44 | 8.34 | 9.40 | 9.40 | 1.50 | 669 | 50.58 | 719.58 | 41.5 | 37 | 10.56 | 7790 | 12.00 | 934800 | 298624 | .319 | | | |
| 45 | | | | | 772 | 52.21 | 824.21 | | 41 | 9.54 | 8800 | | 1056000 | 342046 | .323 | .323 | 9.54 | |
| 46 | | | | | 875 | 53.84 | 928.84 | | 47 | 8.32 | 10000 | | 1200000 | 385468 | .321 | | | |
| 47 | | | | | 978 | 55.47 | 1033.47 | | 58 | 6.74 | 13200 | | 1584000 | 429889 | .270 | | | |
| 48 | 4.34 | 5.40 | 5.40 | 1.50 | 463 | 47.32 | 510.32 | 41.5 | 41 | 9.54 | 7070 | 8.00 | 565600 | 211782 | .375 | | | |
| 49 | | | | | 566 | 48.95 | 614.95 | | 47 | 8.32 | 8075 | | 646000 | 255204 | .394 | | | |
| 50 | | | | | 669 | 50.58 | 719.58 | | 54 | 7.24 | 9370 | | 749600 | 298624 | .398 | .398 | 7.24 | |
| 51 | | | | | 772 | 52.21 | 824.21 | | 72 | 5.43 | 11575 | | 926000 | 342046 | .383 | | | |
| 52 | 4.34 | 5.40 | 5.40 | 1.75 | 566 | 48.95 | 614.95 | 41.5 | 42 | 9.31 | 7775 | 8.00 | 622000 | 255204 | .410 | | | |
| 53 | | | | | 669 | 50.58 | 719.58 | | 48 | 8.14 | 8990 | | 719200 | 298624 | .414 | .414 | 8.14 | |
| 54 | | | | | 772 | 52.21 | 824.21 | | 60 | 6.50 | 10825 | | 866000 | 342046 | .399 | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | |

## Table O.—Part IV.

**Chute No. 6.**—*Centre buckets. Close breast. Bottom of gate 3.66 feet above bottom of wheel.*

| No. of Exper't. | Head of water above. Bttm. of gate. | Head of water above. Top of bkt. | Head of water above. Bttm. of bkt. | Width of Aperture. | Weight raised. | Friction. | Sum of friction and weight raised. | Height raised. | Time. | Velocity per second. | Wt of water expended. | Head and fall. | Power. | Effect. | Ratio, power being 1. | Maximum effect. | Velocity at maximum. | Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Feet. | Feet. | Feet. | In. | Pds. | Pounds | Pounds. | Feet. | Scds. | Feet. | Pds. | Feet. | | | | | | |
| 55 | 4.34 | 5.40 | 5.40 | 2.00 | 566 | 48.95 | 614.95 | 41.5 | 41 | 9.53 | 7710 | 8.00 | 616800 | 255204 | .413 | | | |
| 56 | | | | | 669 | 50.58 | 719.58 | | 46 | 8.50 | 8800 | | 704000 | 298624 | .424 | .424 | 8.50 | |
| 57 | | | | | 772 | 52.21 | 824.21 | | 58 | 6.74 | 10750 | | 860000 | 342046 | .397 | | | |
| 58 | 1.00 | 2.06 | 2.06 | 1.50 | 257 | 44.74 | 301.74 | 41.5 | 60 | 6.50 | 5850 | 4.66 | 273195 | 125222 | .458 | | | |
| 59 | | | | | 360 | 46.61 | 406.61 | | 72 | 5.43 | 7225 | | 337407 | 168743 | .500 | | | |
| 60 | | | | | 463 | 48.48 | 511.48 | | 90 | 4.35 | 8800 | | 410960 | 212264 | .521 | .521 | 4.35 | |
| 61 | | | | | 566 | 50.35 | 616.35 | | 108 | 3.62 | 10925 | | 510197 | 255785 | .501 | | | |
| 62 | 1.00 | 2.06 | 2.06 | 1.75 | 463 | 48.48 | 511.48 | 41.5 | 81 | 4.83 | 8625 | 4.66 | 402787 | 212264 | .526 | | | |
| 63 | | | | | 566 | 50.35 | 616.32 | | 96 | 4.07 | 10325 | | 482177 | 255785 | .530 | .530 | 4.07 | |
| 64 | | | | | 669 | 52.22 | 721.22 | | 123 | 3.18 | 12675 | | 591922 | 299306 | .505 | | | |
| 65 | 1.00 | 2.06 | 2.06 | 2.00 | 360 | 46.61 | 406.61 | 41.5 | 64 | 6.10 | 7025 | 4.66 | 328067 | 168743 | .514 | | | |
| 66 | | | | | 463 | 48.48 | 511.48 | | 77 | 5.07 | 8560 | | 399752 | 212264 | .530 | | | |
| 67 | | | | | 566 | 50.35 | 616.32 | | 93 | 4.20 | 10260 | | 479142 | 255785 | .533 | .533 | 4.20 | |
| 68 | | | | | 669 | 52.22 | 721.22 | | 120 | 3.25 | 12525 | | 584917 | 299306 | .511 | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | |

TABLE P.

CHUTE NO. 6.—*Centre buckets. Inclined above the shaft. Bottom of gate 3.66 feet above bottom of wheel.*

| No. of Experi. | Head of water above. Btm. of gate. | Head of water above. Top of bkt. | Head of water above. Btm. of bkt. | Width of Aperture. | Weight raised. | Friction. | Sum of friction and weight raised. | Height raised. | Time. | Velocity per second. | Wt of water expended. | Head and fall. | Power. | Effect. | Ratio, power being 1. | Maximum effect. | Velocity at maximum. | Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Feet. | Feet. | Feet. | In. | Pds. | Pds. | Pounds. | Feet. | Scds. | Feet. | Pds. | Feet. | | | | | | |
| 1 | 19.34 | 20.40 | 20.40 | 1.25 | 566 | 48.95 | 614.95 | 41.5 | 31 | 12.60 | 4300 | 23.00 | 989000 | 255204 | .257 | | | |
| 2 | | | | | 669 | 50.58 | 719.58 | | 35 | 11.16 | 4825 | | 1109750 | 298624 | .269 | .269 | 11.16 | |
| 3 | | | | | 772 | 52.21 | 824.21 | | 40 | 9.77 | 5650 | | 1299500 | 342046 | .266 | | | The position of this bucket is such that a line parallel to its face, when extended, will pass 15½ inches above the centre of the shaft. |
| 4 | 13.59 | 14.65 | 14.65 | 1.25 | 669 | 50.58 | 719.58 | 41.5 | 31 | 12.60 | 5780 | 17.75 | 1025950 | 298624 | .291 | | | |
| 5 | | | | | 772 | 52.21 | 824.21 | | 36 | 10.86 | 6320 | | 1121800 | 342046 | .304 | .304 | 10.86 | |
| 6 | | | | | 875 | 53.84 | 928.84 | | 41 | 9.54 | 7150 | | 1269125 | 385468 | .303 | | | |
| 7 | 8.34 | 9.40 | 9.40 | 1.00 | 360 | 45.69 | 405.69 | 41.5 | 38 | 10.28 | 4425 | 12.00 | 531000 | 168361 | .316 | | | |
| 8 | | | | | 416 | 46.59 | 462.59 | | 45 | 8.71 | 4600 | | 552000 | 191974 | .347 | .347 | 8.71 | |
| 9 | | | | | 463 | 47.32 | 510.32 | | 52 | 7.52 | 5100 | | 612000 | 211782 | .345 | | | |
| 10 | | | | | 556 | 48.95 | 614.95 | | 67 | 5.84 | 6475 | | 777000 | 255204 | .327 | | | |
| 11 | 8.34 | 9.40 | 9.40 | 1.25 | 566 | 48.95 | 614.95 | 41.5 | 39 | 10.02 | 6260 | 12.00 | 751200 | 255204 | .339 | | | |
| 12 | | | | | 622 | 50.10 | 672.10 | | 41 | 9.54 | 6650 | | 798000 | 278921 | .348 | .348 | 9.54 | |
| 13 | | | | | 669 | 50.58 | 719.58 | | 45 | 8.71 | 7250 | | 870000 | 298624 | .343 | | | |
| 14 | 4.34 | 5.40 | 5.40 | 1.75 | 566 | 48.95 | 614.95 | 41.5 | 42 | 9.31 | 7500 | 8.00 | 600000 | 255204 | .425 | | | |
| 15 | | | | | 622 | 50.10 | 672.10 | | 43 | 9.09 | 7950 | | 636000 | 278921 | .439 | 439 | 9.09 | |
| 16 | | | | | 669 | 50.58 | 719.58 | | 47 | 8.32 | 8600 | | 688000 | 298624 | .434 | | | |
| 17 | 1.00 | 2.06 | 2.06 | 1.75 | 360 | 46.61 | 406.61 | 41.5 | 63 | 6.20 | 6750 | 4.66 | 315225 | 168743 | .534 | | | |
| 18 | | | | | 416 | 47.62 | 463.62 | | 70 | 5.58 | 7525 | | 351417 | 192402 | .546 | .546 | 5.58 | |
| 19 | | | | | 463 | 48.48 | 511.48 | | 79 | 4.95 | 8350 | | 389945 | 212264 | .542 | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | |

TABLE Q.

CHUTE No. 6.—*Centre buckets. Inclined below the shaft. Bottom of gate 3.66 feet above bottom of wheel.*

| No. of Exper't. | Head of water above. Btm. of gate. | Head of water above. Top of bkt. | Head of water above. Btm of bkt. | Width of Aperture. | Weight raised. | Friction. | Sum of friction and weight raised. | Height raised. | Time. | Velocity per second. | Wt.of water expended. | Head and fall. | Power. | Effect. | Ratio, power being 1. | Maximum effect. | Velocity at maximum. | Observations. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Feet | Feet. | Feet. | In. | Pds. | Pounds | Pounds. | Feet. | Scds. | Feet. | Pds. | Feet. | | | | | | |
| 1 | 19.34 | 20.40 | 20.40 | 1.25 | 566 | 48.95 | 614.95 | 41.5 | 29 | 13.48 | 4350 | 23.00 | 1000500 | 255204 | .255 | | | The position of this bucket is such that a line parallel to its face, when extended, will pass 15½ inches below the centre of the shaft. |
| 2 | | | | | 669 | 50.58 | 719.58 | | 30 | 13.00 | 4875 | | 1121250 | 298624 | .266 | | | |
| 3 | | | | | 772 | 52.21 | 824.21 | | 35 | 11.16 | 5475 | | 1259250 | 342046 | .271 | .271 | 11.16 | |
| 4 | 13.59 | 14.65 | 14.65 | 1.25 | 669 | 50.58 | 719.58 | 41.5 | 32 | 12.20 | 5700 | 17.75 | 1011750 | 298624 | .295 | | | |
| 5 | | | | | 772 | 52.21 | 824.21 | | 36 | 10.86 | 6325 | | 1122687 | 342046 | .304 | .304 | 10.86 | |
| 6 | | | | | 875 | 53.84 | 928.84 | | 40 | 9.77 | 7175 | | 1273562 | 385468 | .302 | | | |
| 7 | 8.34 | 9.40 | 9.40 | 1.25 | 566 | 48.95 | 614.95 | 41.5 | 39 | 10.02 | 6370 | 12.00 | 764400 | 255204 | .334 | | | |
| 8 | | | | | 622 | 50.10 | 672.10 | | 42 | 9.31 | 6700 | | 804000 | 278921 | .346 | .346 | 9.31 | |
| 9 | | | | | 669 | 50.58 | 779.58 | | 45 | 8.71 | 7175 | | 861000 | 298624 | .344 | | | |
| 10 | 4.34 | 5.40 | 5.40 | 1.75 | 566 | 48.95 | 614.95 | 41.5 | 43 | 9.09 | 7550 | 8.00 | 604000 | 255204 | .422 | | | |
| 11 | | | | | 622 | 50.10 | 672.10 | | 45 | 8.71 | 7975 | | 638000 | 278921 | .437 | .437 | 8.71 | |
| 12 | | | | | 669 | 50.58 | 719.58 | | 50 | 7.82 | 8700 | | 696000 | 298624 | .427 | | | |
| 13 | 1.00 | 2.06 | 2.06 | 1.75 | 360 | 46.61 | 406.61 | 41.5 | 64 | 6.10 | 6760 | 4.66 | 315692 | 168743 | .532 | | | |
| 14 | | | | | 416 | 47.62 | 463.62 | | 71 | 5.50 | 7525 | | 351417 | 192402 | .575 | .575 | 5.50 | |
| 15 | | | | | 463 | 48.48 | 511.48 | | 79 | 4.95 | 8360 | | 390412 | 212264 | .542 | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | |

[TO BE CONTINUED.]

## AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1831.

*With Remarks and Exemplifications, by the Editor.*

1. For improved *Cushions for Billiard Tables;* Abraham Bassford, city of New York, July 20.

Gum elastic, or India rubber, is to be cut into pieces of about an inch square. These are to be fastened to the cushion rail with glue or cement. Great care must be taken that the faces of the pieces are made with perfect truth. The India rubber is afterwards to be covered with leather, webbing, and green cloth. The claim is to the gum elastic stuffing for the cushions of billiard tables.

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2. For bending *Iron Hoops to be applied to the bottoms of Card and Drawing Cans;* John Butterworth, Philadelphia county, Pennsylvania, July 20.

To preserve the tin cans used with carding and spinning machines, their bottoms are to be furnished with iron hoops, the lower edges of which are to be bent inwards so as to form a flanch for sustaining the bottoms of the cans. It is proposed sometimes to tin these hoops, and to attach them to the can by soldering.

To bend the iron hoops they are to be slipped over round blocks of cast iron, of the proper size. The lower edge of the hoop rests upon a shoulder, and its upper edge stands above the block, over which it is to be bent, either when heated or cold.

The invention claimed is the machine for bending the hoops, and also the soldering them upon the cans.

This mode of bending metallic hoops is so obvious and so common that the only marvel about it is that any one should think of taking a patent for it.

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3. For a *Thrashing Machine;* John Vasburg, Kinderhook, Columbia county, New York, July 20.

The patentee tells how his machine is made, and what it will do, and that it may be worked by horse or other power. The whole story has been so frequently told, that to repeat it would be mere prosing, a thing which we do not admire either in ourselves or others. We read of revolving beaters, an apron, and a concave, but they, fortunately, are not introduced as new, no claim being made.

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4. For an improvement in the mode of making *Steam Engine Boilers,* called the 'safety steam boiler;' John C. Douglass, city of New York, July 20.

We gave at p. 226, vol. vii. the specification of a patent for a steam engine boiler, which issued to the same gentleman on the 17th day of December, 1830. The present boiler is constructed under the same theoretical views with his former; views which are at variance with all the well established principles of natural philosophy,

and which therefore have led the patentee wide of the goal at which it was his hope to arrive.

We are told that the improvement now offered "is founded on the discovery, that very many, if not all, the explosions of steam boilers arise from the fact that a highly rarified state of steam, or a vacuum, exists within the boiler, at the bottom and lower parts of the boiler." The mode in which this vacuum is supposed to be formed is the removal of pressure in the boiler by the opening of the safety valve, or from any other cause. The steam and foam then ascending to the top, leaving a void space below, the consequence of which will be a collapse of the boiler.

In order to fill up this vacuous space, tubes are to lead into the lower part of the boiler, and to be bent up at the outside to the height at which the water in the boiler is intended to stand. The upper ends of these tubes are to be furnished with valves, which open inwards, so that when there is a vacuum formed in the boiler, the valves may open, and admit either air, or water, as may be desired.

This certainly is the most powerful, and at the same time the most capricious vacuum of which we have ever heard; for whilst it sustains the whole load of water, and the pressure of steam in the boiler, it refuses to keep a valve closed which opens inwards to supply the boiler with air or water.

We perceive but little difference in the assumption and principle, or rather absence of principle, upon which the two patents taken out by this gentleman are founded.

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5. For an improvement in the *Manner of Drawing Soda Water;* Ambrose Church, Canandaigua, Ontario county, New York, July 20.

If the security of a patent depends upon the number of persons who obtain it under the character of being the true and original inventors, the present is perfectly safe, as it has now no fewer than five guardians; see p. 166, 247, and 340, vol. viii. and the next article with the remarks there made. The present patentee says that "the patent is not taken for the composition of the ingredients, but for the mode of drawing the water," which is exactly like those referred to. Water, and the proper ingredients for making soda water, are to be placed in two jars. Now although we know something about soda water, we could not tell what ingredients to put into two jars, which by their union would produce it. We are led to the conclusion, therefore, that it is not soda water, but the common effervescing mixture of the physician, which is to be formed.

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6. For an improvement in the *Soda Fountain;* Noah H. Coleman, Mentz, Cayuga county, New York, July 20.

"Another, and another, and another."

We are here told what ingredients the patentee intends to use, as, into one jar he puts a gallon of ice water, with eight ounces of super-

carbonate of soda, and into another seven ounces of tartaric acid, with the water.

Besides these two jars, there may be another containing mead, or "any other liquid" which may adapt the whole to the palates of those who wish for something good.

The apparatus here described is more complex than those of the other patentees, but the design is the same.

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7. For a *Cooking Stove;* Elisha Bates, and David Updegraff, Mount Pleasant, Jefferson county, Ohio, July 20.

This cooking stove has boilers passing through holes in the top, and others with tubes passing through openings in the side; it has also an oven, and various other usual appendages. These are all described at great length in the specification, but there is no attempt in it to point out any thing really new. We have no doubt that when properly managed, it will be a good stove, though not superior to many others.

If a patent can be sustained upon such a specification, it must be upon the particular arrangement exactly as described, for whatever of novelty it may present consists in this.

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8. For *Machinery for Manufacturing Tin Ware;* Edward M. Converse, Southington, Hartford county, Connecticut, July 20.

Those acquainted with the progress made within the last thirty years in the manufacturing of tin ware, know, that with the exception of soldering the work together, nearly the whole of the labour is performed by machinery.

The present patentee has described and figured machinery for turning straight edges—for grooving—for double seaming—for setting down bottoms on vessels—for turning edges for wiring, and for burring.

In their general construction these machines resemble those heretofore known, but with certain alterations which the patentee believes to be improvements; and the whole description of which occupies more than twenty-four pages. He says that they are cheaper, more durable, and perform the work better than any others.

The frame work of his machinery, the wheels, boxes, and most other parts, are made of a compound of zinc, copper, and tin, in the proportion of ten parts of the first, one of the second, and half a part of the third. He mixes these by melting together the copper and tin, to which he adds as much zinc as the weight of both. This mixture is then combined with the remainder of the zinc, in a fused state.

This metal, we are told, is valuable for making a great variety of articles in domestic economy; that it is recommended by its cheapness, and freedom from corrosion, and that it receives a fine polish. The patentee, although he inserts the recipe, does not, we suppose, intend to claim this particular composition as making a part of his patent, as it is a kind of mixture well known in the manufactories of Europe, and in many of our own. He has not, in fact, inserted any claim to it.

9. For an improvement in the *Making of Pasteboard or other Paper;* Frederick A. Taft, Dedham, Norfolk county, Massachusetts, July 20.

The pasteboard, or paper, alluded to, is, we suppose, intended for sheathing, as it is to be saturated with pitch or rosin; and it is the new mode of doing this which forms the subject of the present patent. The pitch, or rosin, is to be finely powdered, and mixed with the pulp of which the paper is to be made. The paper, after being dried, is heated, and passed between hot rollers, which renders it compact.

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10. For a machine for *Excavating and Removing Earth,* called the 'excavator and self-loading machine;' Menoah Alder, and William F. Boyd, Northumberland, Northumberland county, Pennsylvania, July 20.

(See specification.)

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11. For an improvement in the *Grist Mill;* Jehiel W. Dart, Willard Webster, and Hiram Webster, Truxton, Courtland county, New York, July 20.

A suitable frame is made to support the stones, and their gearing. The stones may be about sixteen inches in diameter. The upper stone is stationary, being bolted upon the framing, the lower stone is convex, to adapt it to the upper one. The spindle upon which the runner is fixed, has a step below, and passes through the cap stone into a box above.

"The invention hereby claimed, is the cheapness of the construction of the mill, the grinding surface as before described, and lessening the usual power for grinding."

Cheapness is a very acceptable quality, but, we think, scarcely patentable. Convex and conical surfaces have been before used in such mills, and why the power required for grinding will be less in this than in other mills of the same size, we do not see, and are not told. The difference between this and several other portable grist-mills is so trifling that we are at a loss how to divide the merit of the invention among the three patentees. Using all the light which the claim throws upon this subject, we are led to the conclusion that one of them may have invented the "cheapness," another the "grinding surface," and the third the "lessening the usual power for grinding."

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12. For *Machinery for Cutting Leather, or other substances, into any desired shape, at one operation;* George Domitt, city of Boston, July 20.

The cutting part of this machinery consists of a knife bent into the form of the article to be cut, as the visor of a cap, or the upper leather of a shoe, and fastened to a stock of cast iron, or other suitable material. It is to be forced down by a lever, or any other suitable power.

So far there is no novelty in the invention, as a patent was taken

for such knives, or cutters, about sixteen, and again about three, years ago. The present patentee, however, uses a clearer, or clearers, to force the leather out, after it has been cut; for this purpose there are two bolts which slide freely through the stock to which the knives are fixed. These bolts are borne up by spiral springs so as, ordinarily, to stand flush with the inside of the stock; when forced down, these will push the leather clear of the knives. They may be forced down by causing them to touch against a piece fixed for that purpose, as the lever rises after the cutting.

The claim made is, not to any of the separate parts, but to the combination of the whole. As the main principle, however, that of the knives, or cutters, is not new, the particular arrangement here described may be easily so varied as not to interfere with such a claim.

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13. For improvements in the construction of *Candle Moulds;* Timothy J. Dyre, and Anthony Richmond, New Bedford, Bristol county, Massachusetts, July 20.

These moulds are made and fixed in a frame in the usual way, but the lower ends, or tips, of the moulds are to be made of brass, or other hard metal. The upper plate also, upon which the tallow is poured, is formed of hard metal, and the block tin moulds are soldered to it. One side of the frame, which forms the trough round the moulds, is made to slide down, to facilitate the removal of the superfluous tallow. The improvements claimed are the hard metal tips, and the metal plate which receives the upper ends of the moulds.

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14. For machines for *Drilling or Boring Holes horizontally, or vertically, in stone, iron, or wood;* Ebenezer C. Everts, Greene, Chenango county, and William Lockwood, Colesville, Broome county, New York, July 20.

There is to be a sliding frame which works up and down vertically, in grooves. A vertical shaft, with a drill at its lower end, is affixed to this frame, as is also a crown wheel which takes into a pinion on the shank of the drill. The sliding frame is to be drawn down with any desired force, by weights acting upon pulleys. This machine, we are told, may be placed horizontally or otherwise. The substance to be drilled, or bored, is to stand beneath the frame, and when the crown wheel is turned by means of a crank, the article will be drilled.

If it is intended to drill soap stone, such a machine may do well enough, but if sandstone, granite, or any of the hard stones usually employed, are treated in this way, they will refuse to yield, and will grind the steel more rapidly than the latter will cut them. Those persons who have seen stone drilled, know that there is nothing in this process resembling ordinary drilling, as it is performed by repeated blows from a cutting edge, formed like a chisel. We have described more than one machine for this purpose, in which the pro-

per motion was given to the drill by the apparatus, instead of the usual way of working it by hand.

15. For *Composition Paint;* Philip A. Klipstine, New Baltimore, Fauquier county, Virginia, July 20.

This composition paint is to be made by pouring one gallon of boiling water upon one pound of quick lime, and two ounces of sugar of lead. When the lime has become completely slaked, the mixture is to be stirred, and it is then fit for use. It may be made with less water if required thicker, and colouring ingredients may be added to it, and with them an additional portion of the sugar of lead. It is said, that the cost is about one-thirteenth of that of oil paint, and that it is nearly equal to it in beauty. When exposed to the weather, it ought to be secured by a coat of oil.

16. For a mode of *Manufacturing White Lead;* George A. Harrison, of the city of New York, July 20.

It is the request of the patentee that his specification should not be published at present.

17. For a *Thrashing Machine;* Philip Harrington, Petersburg, Dinwiddie county, Virginia, July 20.

There are to be square iron spikes driven into a cylinder so as to stand out one or two inches, "in such a position that they may lean from a perpendicular line falling upon the centre of the cylinder, towards the front part of the machine." This oblique position of the teeth, we are told, causes the machine to operate with much greater ease than it would otherwise do. The spikes are to form spiral rows round the cylinder, and the spikes of the concave are to be precisely similar to those of the cylinder; but there are to be bars, or plates, of iron placed between the staves of which the concave is formed, and projecting inwards so that their edges stand within from one-eighth to one-fourth of an inch of the spikes on the cylinder.

The claims are to the position of the spikes on the cylinder and concave; to the manner of distributing the spikes; and to the thin bars or plates of iron.

Sloping teeth have been before used. Strips of iron have been made to alternate with the teeth of the cylinder, if not of the concave; and the distribution of the teeth does not appear to offer any thing new.

18. For a *Thrashing Machine;* Ira Crawford, Sweden, Monroe county, New York, July 20.

Another cylinder and concave machine, here presents itself. Iron bars, with teeth, are to extend from head to head of the cylinder, and are to stand obliquely. Whatever there is of novelty in all this belongs to the patentee, the rest to the public.

19. For *Percussion Locks, and Walking Cane Rifles and*

*Pistols;* Alvin D. Cushing, city of Troy, Rensellaer county, New York, July 20.

The percussion lock here described is intended principally to be used in walking sticks, the barrel forming the lower part of the stick. The hammer, which is to be borne up by a spiral spring, strikes in the middle of the breech pin. The particular arrangements are very distinctly exhibited by the patentee, but need not be described here. He says that he believes "the whole principle and manner of operation, as applied to percussion, or any other locks, is new, except the mode of discharging it by force of the spiral spring." This may be the case, but a very neat and compact instrument of this kind was made some four or five years since by Mr. Saxton, in Philadelphia, and percussion gun walking canes have been made and patented in England. The whole thing is a matter of curiosity rather than of utility, and ingenuity may devise various plans for arranging the parts, without adding any thing to the stock of instruments of value.

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20. For an improved *Truss for Hernia,* called the "Gum Elastic Truss;" John J. Heitzleman, M. D., city of Philadelphia, July 20.

The principal improvement here claimed is the forming of the pad of gum elastic, without employing any covering; thereby promoting cleanliness, as this material is not absorbent, and is therefore kept clean with perfect ease. The strap which goes round the body is furnished with spiral wire springs, and there is some novelty in the adjustment of the metallic plate of the pad to the steel spring. This, however, has already been so varied, that much improvement is not to be expected.

Judging from the matter before us, we have no doubt that this truss is altogether a good one.

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21. For making *Lamps of various descriptions and forms out of Wood;* Joseph H. Mather, Saybrook, Middlesex county, Connecticut, July 20.

The drawing and model of this lamp, represent one of the ordinary form, turned entirely out of wood. The only metallic part about it is the plate and tubes through which the wick passes. The cavity, or chamber for oil is to be coated with glue, white lead, varnish, or some other material which will resist the oil, or other fluid to be burnt.

The claim is to the application and use of wood in the construction or manufacture of lamps.

Such lamps will undoubtedly answer the intention very well, as the heat from the wick will never affect the wood injuriously; and when persons become tired of burning oil in them, they will serve to aid in kindling their fires.

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22. For *Propelling Boats by Man Power;* Alexander Renoir, New Orleans, Louisiana, July 20.

This is the age of great mechanical inventions. Watt and his

successors have applied the power of steam in such a way as to produce the most magnificent results; but it was reserved for the present patentee to discover that if they had understood the proper use of their arms and legs, and had known how to make them operate through the medium of levers, wheels, and pinions, as arranged by him, they might have saved themselves no small wear and tear of brains, have propelled boats against the current without danger of explosions, and without the employment of other fuel than bread and cheese.

One man is to propel the boat as well as to steer it; the former he is to effect by his feet, the latter by his hands. The boat too, if we judge from the drawing, will be no plaything.

There are two treadles near the bows of the boat, upon which a man, (Hercules probably,) is to place his feet, whilst his hands manage two tillers, with their ropes, which extend to the rudder in the stern. The two treadles work two pitmen, or shackle bars, which extend back to two cranks, standing in reversed directions on a shaft which crosses the boat, and extends out to the outer timber of the wheel frame. Upon each end of this shaft there is a fly wheel, and a pinion that appears to have on it about sixteen teeth, which take into cog wheels of, apparently, about six times their own diameter. These cog wheels are also the paddle wheels of the boat, as buckets, or paddles, project out from each side of them, and act upon the water.

The reader is now in possession of the whole contrivance, and the commonest mechanician will perceive that although the man at the treadles may be compelled to blow off his steam, the boat will obstinately resist all his efforts, notwithstanding the *aid* of the fly wheels. His crank shaft must perform six revolutions whilst the paddle wheel turns but once. Should the patentee attempt the voyage from New Orleans to St. Louis, we advise his friends to keep a good look out for him at the Balize. The time of his arrival may be pretty accurately calculated by the passage of drift wood down the Mississippi.

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23. For a *Cooking Stove;* Thomas Woolson, Claremont, Sullivan county, New Hampshire, July 20.

The form of this stove is such as to give it the appearance of two ordinary cooking stoves joined together. One of these parts constitutes the fire place, the other the oven, and surrounding flues; the back plate of the fire place forming one side of the oven.

The claims made are the placing the two parts of the stove, horizontally, side by side; the mode of turning the blaze and smoke round the oven; the arrangement of dampers, by which the blaze may be admitted into the funnel without passing round the oven; and the method described in the specification, of making the fire place in one, or dividing it into two parts, by a moveable plate.

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24. For *Manufacturing Rollers of Cast Iron;* James Wood, city of Philadelphia, July 20.

(See specification.)

25. For *Manufacturing Potash from Wood Ashes;* Ephraim Pearce, Lincklaen, Chenango county, New York, July 20.

Leaches are to be prepared by placing sticks, straw, and quicklime, in the usual manner. They are not to contain more than six bushels of ashes, which must form a stratum of from eight to fourteen inches in thickness. Forty-five gallons of water, containing six pounds of salt, are to be heated to near the boiling point, and half a bushel of unslaked lime is then to be thrown in, which will immediately produce boiling. A bushel of ashes is to be boiled in another kettle with six gallons of water. A bushel of ashes is then to be put into the leach, and upon this three gallons of the boiling lime water are to be poured and allowed to soak in. Ashes are then to be added, a bushel at a time, with six gallons of the lime water after each, until the intended six bushels are in the leach. The remaining lime water is to be poured on, six gallons at a time, allowing it to disappear between each pouring.

Three gallons of cold water are then to be put into the kettle of boiling ashes and water, when a quart or two of slaked lime, and a pint, or less, of salt, are to be sprinkled on; after removing the coals, &c. by skimming, six gallons of this water are to be put into the ley kettle. The remainder, with the ashes, is to be put into the leach; cold water is afterwards to be poured on the leach until the strength is out. This leached liquid is to be put into the ley kettle containing the above named six gallons, and the boiling is then to be effected in the ordinary way; which, the patentee says, will at once produce the best quality of potash. He adds, that ashes, which, worked by the ordinary process, will produce one ton, will, by his method, yield *more than two tons.*

We have been at some pains to give the whole process by which the patentee says he produces a result so extraordinary, as we are altogether unable to discover in it any thing to justify the assertion; nor are we prepared to believe that manufacturers of potash have hitherto been in the habit of throwing away more than one-half of that which is contained in the wood ashes.

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26. For an improvement in the *Fly Net for Horses;* Peter Mintzer, city of Philadelphia, July 20.

The patent granted to Henry Korn, of Philadelphia, (see vol. iv. p. 409,) is noticed, and the description of his net inserted in the present specification. The improvements claimed by the present patentee, is the using net work, and tasselling of silk, or other braid, instead of the parts which form the longitudinal straps in the former. The net so made, is said to be lighter and more convenient in use, as well as much handsomer. The difference, however, is very trifling.

There is no drawing of this fly net, but a "specimen deposited in the patent office," is referred to; we apprehend that the specimen might be exhibited in a drawing; and therefore that it ought to have been done, as the law expressly requires a "drawing with written references, whenever the nature of the case *admits* of drawings."

27. For a machine for *Cleaning Grain from Dirt;* Thomas Reese, Jones' Falls, near Baltimore, Baltimore county, Maryland, July 20.

This machine consists, mainly, of a hopper, and rubbing plates, formed of sheet iron, to which motion is given by a crank. The lower rubber forms a plane a little inclined from the hopper, and is similar to the upper one, with the exception of being stationary. We are told in the specification, that the rubbers "are made by punching grooves and ridges in sheet iron, about half an inch deep, eighteen inches wide, and seven feet long, and fastening them on boards." As this description does not appear to us to be very luminous, we have given the exact words.

The claim is to "the before described machine for cleaning grain from all kinds of dirt."

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28. For a *Plough;* Barnabas Thacher, jr. Barnstable, Barnstable county, Massachusetts, July 20.

This plough is to be made upon any known principle; but the beam is to be rendered capable of having its direction altered, either upwards, downwards, or laterally, by means of screws, wedges, or otherwise. The claim is to the making a plough capable of this alteration.

The scratch of a pen, which, under the name of a drawing, accompanies the specification, lends but little aid to the description; the object, however, can be understood without it. We have, more than once, seen the farmer alter the set of his plough on the beam, by means of screws or wedges; but hereafter this will, of course, be forbidden by the present patentee.

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29. For a machine for *Dressing Staves and Heading, and for Jointing;* John B. Tackels, Pomfret, Chatauque county, New York, July 20.

This may possibly be a very good machine, but as the specification, with the aid of the drawing, does not enable us to understand its particular structure, we must pass it by until we receive more light upon the subject. There are to be revolving cutters, fixed somehow, and jointers operating someway, to leave the stave with its required bulge. No claim is made.

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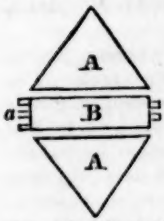
30. For an *Easy Motion and Pavement Saving Wheel,* for Carriages of all descriptions; Felix Varela, of the city of New York, July 20.

We have heard of fortifying a city with leather, and the present invention takes one step towards the carrying this plan into execution, as our pavements are to be defended against the martial attacks to which they have hitherto been subjected by the hard tyre which has surrounded them. Every wheel, hereafter, is to carry with it, *a leather rail road,* altogether novel in its construction, and unique in its appearance.

In the first place the wheel is to be put together without iron tyre, but is to be closely embraced by a double strap of leather. A number of wooden boxes, or rattle-traps, are then to be prepared, by taking two triangular pieces, A A, and one rectangular piece B, equal in width to the thickness of the wheel.




Upon the edges of this piece are to be nailed, or screwed, the triangular pieces, which triangular pieces will then stand parallel to each other. These wooden boxes are to be hinged together, at *a*, *a*, so as to form a chain considerably longer than the circumference of the wheel; but not sufficiently so to allow the angles of the boxes to leave the rim of the wheel. Leather is to be nailed upon each of the rectangular pieces B, which surround the wheel, and a continued or endless strap, is to be affixed within the whole of them, by small straps attached to the iron hinges. When one of these is put round each wheel, the system is ready to operate.

The chain of triangular boxes being somewhat larger than the wheel, allows, according to the drawing, two of them to lie flat upon the pavement.

We assure the reader that we are not joking, but have given as honest and exact a description of this truly astonishing contrivance, as we are capable of doing. Should the patentee make a public trial of his invention in the city of New York, he will attract a degree of attention, and acquire an amount of notoriety, which few beside will obtain. As muddy streets are unfavourable to such a concern, we hope the corporation of that metropolis will allow the scavengers to take the lead in the procession.

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31. For a *Machine for Cutting Paper;* Edward Pine, city of Troy, Rensellaer county, New York, July 20.

A knife made of saw plate, or any plate steel, is to be fixed to a frame which works up and down in vertical cheeks. The reams of paper to be cut are placed upon a shifting platform, under the knife, which is to be brought down upon it, by means of a lever. The patentee claims the use of knives so made; the use of lever power in bringing the knife down; the cutting of wet paper, made by cylinder machines; and the use of the machine in cutting paper "not interfering with any other improvement heretofore known or used."

A patent was granted to John M'Clintock, of Chambersburg, Pennsylvania, on the 31st March, 1827, for a machine for trimming the edges of paper; which machine consisted of a knife, brought down by a lever, similar to that above described. This probably may be news to the present patentee, but if the two interfere, as we are convinced they do, the concluding proviso of the claim will not operate as a saving clause.

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32. For a *Press for Cotton and other fibrous substances;* Philenzo Payne, and Joshua Rundell, Port Gibson, Claiborn county, Mississippi, July 20.

This is a vertical press, the follower of which is to be forced down by toggle joints. Within each of the cheeks of the press there is a toggle joint, from the middle of each of which an arm or shaft, extends forward of the press, in a horizontal direction. The power is applied to these arms, to draw them forward, and consequently, to bring the levers of the toggle joints in a right line with each other. The lower sides of the projecting arms form racks, which take into teeth upon a cylindrical shaft, crossing in front of the press. A vertical shaft turns the horizontal one by means of bevel gear. A horse, or other power, may be applied through the medium of a lever, or sweep, to the vertical or main shaft, when the follower will descend. The claim is to the press as described.

We apprehend that this will not be a good press for the purpose intended, on account of the smallness of its range. When a follower is to go but a short distance, and to act with immense power at the end of its range, as in the printing press, the toggle joint offers every possible advantage: but the pressing of cotton, and other light fibrous articles, requires a press with a very long range, as well as of great power, and there are many presses now in use for this purpose, which combine these qualities in a way greatly superior to that now proposed.

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33. For a *Machine for Planing Boards;* Joseph Percival, Northern Liberties, Philadelphia county, Pennsylvania, July 20.

If this machine is a good one, it is unfortunate in not coming before us with a favourable introduction. A more inadequate description could not well be given, and although considerable pains have been taken with the drawings, they afford but a very incomplete representation of the details of the machinery. Some of the wheels are called segment wheels, whilst, according to the drawing, there is not one answering to this name in the whole machine.

The cutters, or irons, are, it seems, to be fixed in a frame, and are to operate in the manner of ordinary plane irons, the frame containing them being passed backward and forward over the board, by a chain attached to it. The driving wheel is a large cog wheel, called a large *segment* wheel. This drives two pinions, or small cog wheels, also called *segment* wheels. The shafts of these pinions have wheels upon them, which take into the links of the chain which moves the plane. There is a contrivance for throwing these latter wheels alternately out of gear, in order to change the direction of the machinery.

The whole apparatus is complex, and inartificial; and is certainly very inferior to some of the planing machines previously in use. There is no claim made, the general arrangement being undoubtedly, and, we apprehend, correctly, considered as new.

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34. For an improvement in the Machinery for *Winnowing and Cleaning Grain;* Joseph D. Prescott, Chesterville, Kennebec county, Maine, July 20.

A trifling alteration in the mode of working the Dutch wheat fan, as generally used, constitutes the whole of this invention, all that is claimed being a kind of cam shaft, for moving the shoe and sieves, called by the patentee a "re-acting screw shaft," and an arrangement for altering the inclination of the sieves.

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35. For a *Plough;* Albert Peebles, Henry county, Georgia, July 20.

This plough is to be used in the cultivation of cotton, and of corn. It is furnished with two feet, on each of which there is a shovel iron, or a shovel iron on one of them, and the other made in the common form of the share plough.

The *inventor* states that this contrivance was made by him in May, 1816. He has been somewhat tardy in obtaining a patent, and if his neighbours have used it during the interval, which they had a perfect right to do, his claim now will prove something worse than equivocal.

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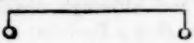
36. For a *Thrashing Machine;* James B. Palmer, city of Baltimore, July 20.

The beaters of this thrashing machine pass from one circular head to another, on a revolving shaft; but they are not fixed immoveably to these heads as is ordinarily done, but each of them works upon joints at their ends, allowing them to give way in passing over the straw after the stroke. To effect this they are bent at right angles at each end, thus,  and a pin, or screw, passing through an eye on the bent parts, attaches them to the drums, near their peripheries, and thus affords them the required play: about six of these beaters, standing two inches clear of the heads, is considered a good arrangement. The other parts of the machine differ but little from those generally used.

It is proposed sometimes to remove these beaters, and to attach to the heads, pieces furnished with spikes, and also to add a concave with spikes; thus converting the machine into the common cylinder thrashing machine. The beaters, as described, are claimed, and also the converting this instrument into a thrashing machine of the usual form, by the alteration above indicated.

We do not recollect having seen moveable beaters constructed and attached in the manner above specified, and think this therefore a valid claim; the second, however, we think altogether equivocal, as it consists merely in converting the original machine of the patentee into one for which he, confessedly, could not hold a patent.

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37. For a *Smoke Preventor;* Levi Silliman, city of Albany, state of New York, July 20.

This smoke preventor is an iron chimney cap, intended by its

particular construction to prevent the smoke from being blown down the flue, in whatever direction the wind may be. The mode by which this is attempted to be accomplished is the causing of the wind always to strike upon an inclined plane, by which it shall be directed upwards, and carry the smoke with it. The subjoined sketch, may represent one of the iron plates, with openings at *a*, *a*, *a*; the lower sides of these form the inclined planes, whilst the upper sides, with dotted lines, are unobstructed.

Plates, it is observed, may be fixed in the flue itself, having the required inclination, and openings left in the sides of the chimney will then serve the purpose of the proposed cap.

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33. For an improvement in *Fire Places*, called "the inverted arch, or curved mantle, for fire places." Elijah Skinner, Sandwich, Strafford county, New Hampshire, July 20.

This is intended as an improvement upon a plan patented by the same gentleman in April, 1822. He now proposes to form the upper part of the fire place by bending iron or brass plates, long enough to reach from jamb to jamb, so that they shall form segments of cylinders. These are to be fixed with the concave side outwards, the convex sides forming the front of the throat of the chimney, having the same curvature which Count Rumford prescribes for this part. When houses are newly constructed, it is proposed to form these breast pieces of cast iron, which may be built into the brickwork and form its support, instead of the ordinary arch, or iron bar.

We do not perceive in what respect this is an improvement upon Rumford's mode of construction.

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39. For a *Cutting and Punching Machine*, for iron, copper, brass, &c.; John Shugert, Pittsburgh, Alleghany county, Pennsylvania, July 20.

This machine consists mainly of the common cutting shears worked either by a double or single lever. That side of the shears which rises is kept in its place against the stationary cutter by a standard in the bench, which standard presses upon the outer side of it, and is capable of being adjusted to it.

The punching part consists of a punch fixed in the upper shear, just in front of the cutters, with a bed piece upon the bench below it. As the lever, therefore, forces down the cutting shear, it will cause the punch also to operate.

"The part of the above machine which the *inventor* particularly claims, is the post and slide at the back of the upper frame, and the power by which it operates." And we think that this is claiming quite enough in all conscience, as nothing is more common than to allow the shank of the upper shear to rise between cheeks; and "the

power by which it operates," is universally employed for the same purpose. What has become of the punching part?

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40. For a *Machine for Weighing;* James S. Seger, city of New York, July 20.

Without a drawing we cannot give a precise idea of this machine, and although there is some ingenuity in its construction, we apprehend that it will not, to any extent, supersede the usual process of weighing, and shall be satisfied with giving a general idea of it.

The weight of any article is to be indicated upon a flat round metallic plate, which is suspended vertically by a clevis and ring above it. When a weight is hung to a hook, pendent from a clevis which receives the circular plate in a slot, and allows it to play freely, the plate is canted on one side in a degree proportioned to the weight. An index upon the plate, which turns loosely upon a pin, and, therefore, always hangs vertically, points to figures which indicate the weight.

The circular plate, and the loosely pendent index for pointing out the weight, constitute the claims.

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41. For a *Machine for making Hooks and Eyes;* James Stewart, formerly of Montrose, in Scotland, but for two years past a resident of the city of Boston, in the state of Massachusetts, July 20.

This is a very complex machine, but it is perfectly well represented in the drawing, and fully described. Machines for the same purpose are in use in different countries, and how this may compare with those before known we are unable to say.

The claim made is to the combination of well known machines, or elements of machines, to produce the intended effect.

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42. For a *Machine for preparing Mortar for making Bricks;* Oran W. Seeley, Williamson, Wayne county, New York, July 20.

This machinery, in its general structure, resembles some others now in use for the same purpose. A circular trough is prepared into which the clay is to be put. A horizontal shaft, working upon an upright in the centre of the trough, when forced round, causes wheels to run over the clay, the wheels having a traversing motion to and from the centre. The arms of the horizontal shaft have each a screw cut upon them, these work in the hubs of the wheels, and cause them to traverse; one of them is a right, and the other is a left handed screw; in consequence of which, both the wheels recede from and approach the centre at the same time. Each wheel, instead of having a single rim, has four rims, or sets of felloes, supported by spokes from one common hub, the advantage of which is manifest.

The claims are to the right and left handed screws, and to the particular construction of the wheels.

43. For an improvement in the *Axles of Wheels for Railway Carriages;* Ross Winans, city of Baltimore, July 20.
(See specification.)

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44. For a *Lever Power and Inclined Wheel for Propelling Machinery;* Peter Wykoff, Westfort, Oldham county, Kentucky, July 20.

We have here the ghost of Redheffer's perpetual motion. This sprite, it appears, has been called from "the vasty deep," or elsewhere, has wandered towards the west, and taken up its abode with the present patentee. On revisiting our country he has evidently acquired more confidence than formerly, as he comes forth without that disguise with which he was enveloped in his Redheffer service.

The *inclined wheel* above named, is a *vertical wheel*, the axis of which is horizontal; upon the rim of this wheel a kind of carriage is to be placed, which carriage, as carriages ought to do, rests also upon wheels of its own. As this carriage is placed about forty-five degrees from the apex of the *vertical inclined* wheel, the vehicle will itself be inclined to run down, and fall to the ground. To counteract this inclination, a strap passes round a whirl, or drum, connected with the carriage wheel, and, inclining upwards, embraces another whirl, connected with ratchet wheels and palls, which are to correct its inclination to work too rapidly. To this system of ratchet wheels and palls there are appended various other contrivances to communicate the latent motion which exists in the inclined carriage, in proportion to its load, and which for its development requires nothing more than to cut the strap by which its inclinations are checked.

To the curious who wish for further information upon this subject, we can only give a reference to the files of the Patent Office, as we have, no doubt, already said more about the affair than will accord with the inclinations and anticipations of the *inventor.*

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45. For a *Compound Revolver for Roping Cotton;* Asa Whitman and Joel Baker, Walpole, Norfolk county, Massachusetts, July 20.

This is a very ingeniously contrived apparatus, and one which we have no doubt will accomplish its purpose in a very satisfactory manner. The patentee states that it is not only more simple than the instruments in common use, but that it is operated on with much less power, is more readily adapted to different numbers of roping, and is easily kept in repair.

A verbal description of it, without a drawing, would be altogether unsatisfactory, and therefore we shall not attempt it.

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46. For an improvement in the *Making of Pumps,* for drawing water from wells; Shadrach W. Allen, pump maker, Geneva, Ontario county, New York, July 21.

A pump maker ought to know how pumps have been made; especially such pumps as are familiar to those who are at all conversant

with the subject. As, however, we have lawyers who have acquired but little knowledge of law, and doctors who have never studied medicine, we may well excuse the artisan who manifests a want of learning in the history and progress of the arts.

The pump before us has two barrels, and two piston rods, worked by one lever. We are told that "all the interior is of metal, excepting the lining of the valves, the block, and a part of the lever," and that a spring passes round the piston, and keeps the leather covering quietly pressed against the chambers. This pump the patentee avers is superior to any other now in use; which superiority results from its having two chambers and pistons moving alternately in opposite directions, thus keeping up a constant stream. He says, also, that it has less friction than the common pump, and will deliver more water with less power applied.

If there is a common fire engine in Geneva, the patentee may see his two chambers, pistons, and rods, and all of them made of metal; and if he will turn to any good work on hydraulics, he will find that a double chamber pump is no novelty in its application to other purposes. Although he does not specify his claims, the above named are the points most prominently noticed in his description, and we infer, therefore, that these were intended to be the subject of his patent.

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47. For a *Thrashing Machine, and a Horse Power, for operating said machine;* Nehemiah P. Stanton, Syracuse, Onondaga county, New York, July 21.

The thrashing machine is described in the usual terms, applied to this instrument; we have talked about the different parts so frequently, that we are tired of the subject. There, however, is a claim made in the present instance, which is to "the uniting beaters and spikes on the same cylinder with the cast iron concave bed, and the sheet iron cap, and the construction of the dust discharger." All that is said about the dust discharger is, that "there is a feeding table, with a throat to receive the grain, and directly over it a throat to discharge the dust."

The horse power consists of a large horizontal wheel turned by a lever, projecting from its vertical shaft; this is geared to a smaller wheel which turns a horizontal shaft carrying a drum and strap, which gives motion to the thrashing machine, or to any other machinery required to be operated upon. So far all is according to the well established plan of such machines; the novelty of this horse power consists in placing the wheel work under ground, and allowing the main shaft to project up through the framing, the horse walk being above them. A *diamond* gudgeon is to be formed on the top of the vertical shaft, to receive the mortice of the lever by which the horse draws. The claims relating to the horse power are to the running of the gearing below the lever by which the horse draws. The communications from it to the thrashing machine, by bands, ropes, &c. &c. &c., the placing the lever at top, and the diamond gudgeon.

This patent is taken, not only plainly, but confessedly, for two

distinct machines, the application of the horse power to other purposes being particularly noticed; they should, of course, have been the subject of two patents; the claims to the two are separately made as to two machines. But independently of this consideration, there are parts of each of the machines claimed, which present no novelty whatever.

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48. For improvements in the *Machinery of the Steam Engine*, parts of which may also be applied to the gates of water mills, canal locks, &c.; William A. Turner, Washington county, North Carolina, July 21.

The present patentee has laboured very assiduously for the attainment of his object, as we have already noticed two patents obtained by him within about four months, each having the same end in view and by means very similar. The first of these is noticed at p. 14, vol. viii. and the second p. 112 in the same volume. The specification before us extends to twenty-seven closely written pages, and to as many of drawings and references, and although several of its propositions now made bear a very near resemblance to, and are indeed identical with those in the patents which preceded it, there are, of course, some novelties presented to us.

The propositions relative to the steam engine are, 1st, to ascertain the quantity of water in the boiler. 2nd. To prevent its overheating. 3d. To open large holes for the escape of steam when necessary, and to force a considerable quantity of water into the boiler at once. 4th. To cause the induction valves to open with great ease.

We can give no more than a brief notice of these various propositions; and, most probably, the greater number of our readers will wish that we had been still more brief.

*In order to ascertain the quantity of water*, the boiler is to be suspended on a balance, like a scale beam, or it is to be contained on a float, by which both it and its contents may be accurately weighed; there being an index to point out the weight, or otherwise an alarm is to be sounded as it ascends by becoming too light. There is to be an apparatus of wheels, &c. to move the index for pointing out the weight; or when the boiler is made to float in a shallow box containing water, and fitting into it water tight, a tube is to extend upwards, to weigh the boiler, &c. hydrostatically, by the ascent of water from the reservoir.

We have not time, and, to any engineer it would be labour lost, to animadvert on the absurdity of this proposition; not on account of its mechanical difficulties merely, but from the absolute impossibility of carrying it into effect in a working engine. Besides the ascertaining of the actual weight of water, the boiler, as it rises by its levity, is to let go a damper, to check the fire, and at the same time to open certain apertures, which are to pour water on the fuel.

*To prevent overheating*, the inside of the boiler and flues, in contact with water and steam, are to be coated with such metal as may be found least apt to rust. This, of course, must be silver, gold, or

platinum; how this lining is to effect the purpose, we do not perceive. Tubes are to pass entirely through the interior, and the top and bottom of the boiler; in these tubes plugs of fusible metal are to be inserted near to their lower ends: rods are to extend down these tubes and rest upon the fusible metal, and when this compound melts, the rods are to descend, and pull down levers which shut the aforesaid damper, and open apertures admitting a shower to fall upon the fire.

*To open large openings for the escape of steam*, small valves are to be provided, which are to act upon certain doors, and thus open large holes, for the discharge of the steam, and they are at the same time, like the other contrivances, to close the damper, and to open the holes which are to deluge the fire. We were about to give some idea of the method by which the steam issuing from the small valves, is intended to open the large doors alluded to, but it would require too many words, and we must spare ourselves and our readers this trouble; referring those who wish to know all about it to the specification. We must also take the same course as regards the easy opening of the valves, and the application of the same principle to the gates of water mills, and to the locks of canals. Like the former patents of this gentleman, his propositions are made, without specifying those parts which are new; and the same things are in some instances proposed in each of his patents. Most of his contrivances it is true, have the merit of novelty; we wish that we were able to add, and of utility.

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49. For *Fastenings for Doors and Windows;* James R. Post, city of New York, July 21.

This fastening is a spring bolt. A tube is to be provided which will receive the bolt; a spiral spring is to be put into this tube, and the bolt then passed in over it. In the edge of the lock rail of a door, or the rail of a sash, a hole is to be bored, to admit the tube with its bolt. Knobs are to be applied, to force the bolt back: for this purpose a slot is left in the tube, and a screw hole made in the bolt; a corresponding mortice, or opening, must, of course, be made in the rail, through which the knob may be screwed into its plate, and fly backward and forward.

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50. For an improvement in machinery, called the *Circular Wedge;* Silas Underwood, Hardwick, Caledonia county, Vermont, July 22.

The so called *circular wedge*, here patented, is no more than the common eccentric, so generally applied to machinery. We are told that it is a complete substitute for the crank. It is represented as applied to a saw mill, and also to the beaters of a fulling mill. Were it new, it would be no improvement as applied to the former, and if used to move the latter, it would be but a poor affair. Has the patentee lived in the present day without seeing his *circular wedge* applied to the opening and closing of the valves of a steam engine?

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51. For an improved *Metallic Mould for casting Butt*

*Hinges;* Jonas Kendall, jr., Watertown, Middlesex county, Connecticut, July 21.

A metallic mould suitable to receive the metal, is made in two parts; these are to be fixed opposite to each other within double levers, which open and close like tongs. The moulds are held together, the metal poured in, and on liberating them, a spring between the levers separates the two parts, and a pin forces the cast piece out, before it has time to cool, so as to harden or break.

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52. For a *Thrashing Machine;* Benjamin Balch, and Luke Webster, Sweden, Monroe county, New York, July 22.

The claim made, is to the placing the iron beaters which surround the cylinder in an oblique direction, alternately sloping different ways. The object proposed by this arrangement has been repeatedly effected.

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53. For a Machine for *Cutting Dye Woods;* Merrit Hurd, Augusta, Oneida county, New York, July 22.

There is a part of this machine, which, in the specification, is called a cylinder; but it is in fact the frustrum of a cone: one of its ends is six, the other ten inches in diameter, and eight in length. This part is made of cast iron, about five-eighths of an inch thick, and with a head or bottom to the smaller end; through this passes a horizontal shaft, by which it is made to revolve. A longitudinal mortice, like the mouth of a plane, is made to receive the iron which is to cut the dye wood, the chips from which pass through to the inside of the cone, and fall out from its open end. There is a rest provided to sustain the wood to be cut; and a weighted arm upon the shaft, to operate as a fly wheel, to give momentum to the cutter.

There is no claim made, the general construction of the machine being considered as new. It is certainly simple, and, we have no doubt, effective.

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54. For an improved *Corn Plough;* Nathaniel Ethridge, George Heath, and Ira Glynn, Little Falls, Herkimer county, New York, July 23.

This is a plough, which consists of several parts, which are made to shift, in order to adapt the instrument to the respective purposes which it is designed to answer.

When the plough is used for ridging and hilling, it has a mould board, which is double, throwing the earth equally each way, and a chip with double wings. There is also an instrument called a drag, which is sometimes connected to the plough by suitable irons. This is used, for example, in the first hoeing and weeding; the mould board being removed, but the share and chip remaining in their places. The drag operates as a harrow, or rake; it consists of two bars of iron, standing obliquely to each other, their wider opening being towards the plough, and furnished with teeth which drag upon the ground.

The claims are to the chip with double wings; the double mould board, made to take off; and the cast iron harrow, or drag.

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55. For a *Thrashing Machine;* Jacob Redifer, Philadelphia county, Pennsylvania, July 25.

The parts of this thrashing machine are the same with those most frequently described; the position of the hollow segment is, however, different from that usually adopted, as it is placed directly over the revolving beaters, or cylinder. The feed board is inclined upwards, so that the straw may pass over the cylinder, and under the segment, which has a cap to retain the grain. The cylinder must, of course, revolve in a direction the reverse of most of those used; and the grain and straw are to be delivered in front, a little above the axis of the cylinder. A rack of wood, or wire work, extends from the front of the machine in an inclined direction, to carry the straw out of the way, and allow the grain to fall through.

The claims are to the position of the feed board, with its highest end towards the cylinder; and to the rack in front of the machine. Our impression is that the claim to the latter is of doubtful validity, as there are machines patented, which thrash and winnow at the same time; the grain and chaff falling through a rack, or screen, in front, and being then operated upon by fans.

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56. For a *Thrashing Machine,* for thrashing rice, and other small grain; Samuel Rogers, Ashville, Buncome county, North Carolina, July 28.

The only difference which we discover between this and the great number of thrashing machines, consists in the ease with which the patentee avers that it operates; for although it is precisely like many others, he declares that it may be worked with half the power usually found requisite. The "why and because" are not given, nor is there any part designated, or claimed, as new.

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57. For a *Brick Press;* Thomas A. Fricks, Harrisonburg, Rockingham county, Virginia, July 29.

There is nothing very special in the construction of this press, to mark its superiority over others previously in use. The brick is placed in a double mould, which is then slid to its place, when a lever, attached to the lower framing of the press, is forced down, and brings a piston to bear forcibly upon the brick; as this lever is brought down, it acts upon another, which raises the brick to the top of the mould. No claim is made.

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58. For improvements in the *Machinery for Cleaning Rags,* used in Paper Making; George Carriel, Manchester, Hartford county, Connecticut, July 27.

A common screen for cleaning rags, used either with or without pins, or knives, is to have wings, composed of thin pieces of wood or metal affixed upon its outside, and extending from end to end, in order to create a wind by their motion. This screen is to be placed

in a round case, or chest, a little larger than itself. An opening is left along the whole length of this chest; which opening, if the screen be four feet in diameter, may be about sixteen inches wide. The whole should be in a large enclosure. The rapid motion of the cylinder will carry the dust through this opening. The improvements claimed are the use of the wings, as described; and the case with the opening for carrying off the dust.

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59. For an improvement in the *Running of Stones for Flour Mills;* John Clyde, Fallowfield, Crawford county, Pennsylvania, July 27.

The object of this patent is to secure the particular construction of the spindle, and the step in which it works. The upper stone is to be the runner, the spindle being fixed in it for that purpose, and extending above to a piece of timber in which its upper end revolves. A bolt of iron extends through the lower stone. The upper end of this iron bolt is hollowed out, and forms a step for the running spindle; it is fitted so tightly in the stone as to be raised by a hand pole, attached to the bridge tree, and to be lowered by the weight of the upper stone. The stone is to be propelled by a whirl on its top, with an opening over the eye. The claim is to the spindle and step.

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60. For a *Bee House, and the Cultivation of Bees;* Philip Munch, Putnam, Muskingum county, Ohio, July 27.

The bee house, ten and a half feet long, and four feet deep, may contain three different apartments. It is proposed to place the front of the house towards the east. The house is to stand upon legs, consisting of timber properly framed together. The roof is to slope back, and each of the compartments is to be furnished with a door, two feet long, and two feet wide, to allow of putting a hive into it. This door may be furnished with a pane of glass. The apartments are to be closely planked without and within. Openings are to be left in front for the entering of the bees, and ledges placed along for sheltering them, and for them to alight on. When a hive of bees is placed in one of the compartments, the top of the hive is to be gently removed with the proper precautions. The rooms, or compartments, are cleated round, to sustain small sticks, which, with the cleats, support the comb which the bees will eventually build around the hive, and on to the sides of the compartments. The hive is to be raised from the floor by a block under each corner, to allow a free passage for the bees.

A swarm of fresh bees may, if preferred, be put in without a hive; the great object being to give them abundant room, that they may not be compelled to swarm, as from a common hive. By thus giving them ample space, it is said that many advantages are secured Swarms often perish from their swarming late in the fall, which this plan prevents; the practice of killing the bees is rendered entirely unnecessary, as the comb may be cut out at any time when it may be wanted for use, especially in winter; the bees having ample room, will have no inclination to swarm, and will therefore collect honey much more rapidly than usual.

61. For a *Hoop Split Shaving Machine;* Gabriel Heatwoal, Harrisonburg, Rockingham county, Virginia, July 27.

Splits are first to be made out of white oak, or hickory, in the usual way. The machine for shaving them consists of a bar of iron, or steel, which is fixed upon a bench; and upon this the knife, or shaver, is brought down in the manner of the upper blade of a pair of shears, it working on a joint for that purpose. On the edge of this knife there are notches, the size of the hoops to be shaved. The ends of the splits are fastened upon a drum, or cylinder, in front of, and close to, the knife, which is then closed upon them. The cylinder is turned by a crank, which draws the splits through, and at the same time bends them round the cylinder.

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62. For an improvement in the *Net for Covering Horses;* William H. Horstman, city of Philadelphia, July 28.

This differs about as much from the netting patented by Mr. Mintzer, and noticed at p. 48, as two nets made by the same workman might be supposed to differ from each other, when he determined to make some variation in his pattern. The nets are to be made of braid or cord, of worsted, cotton, or silk. It is to be knotted on the upper part in meshes of about an inch square, but is to have a border more closely woven. There is to be a leather strap in front, running round the breast of the horse, and strings of braid are to hang loosely from its edges. The claim is to this mode of making braid netting for horses.

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63. For a *Bolting Machine to separate Clover Chaff from the Straw;* John Bolton, Harrisburg, Dauphin county, Pennsylvania, July 28.

A bolting box is to be made of thin boards. It may be ten or twelve feet long, either round or polygonal; one of six sides being preferred; it may be two or three feet in diameter. The boards are to be sustained by three bands passing round them on the outside, and are to be bored full of holes about five-eighths of an inch in diameter. The bolt, we are told, may be made of basket work, or of wire. It is to be placed a little inclined, and turned by any suitable means, which will separate the chaff from the straw placed within it.

What this is more, or other, than a common revolving screen we cannot tell.

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64. For an improved *Machine for Breaking Hemp;* William Greathouse, Maysville, Mason county, Kentucky, July 28.

A wheel, or platform, twenty or thirty feet in diameter, is to be fixed on a vertical shaft, so that it may turn freely in a horizontal direction. The outer edge of the wheel is formed of triangular slats placed about an inch apart, and having one angle upwards. Upon this part the hemp to be broken is to be laid. Two or more rollers, or nuts, grooved from end to end, so as to mesh into the slots, are fixed so as to revolve by the turning of the wheel, and to be capable

of rising and falling according to the thickness of the hemp beneath them. These may be weighted in any desired degree. They must be so placed as to balance each other on the great wheel.

The claim is to the breaking of hemp by placing it on the slats of this circular platform, and allowing the rollers to act upon it, the shives falling through between the slats.

This machine is much more simple than most of those for the same purpose which we have formerly described; this would be an important recommendation, should it prove equally efficient; we apprehend, however, that it will perform its work in a very imperfect manner.

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65. For a machine for *Cutting, Punching, and Pricking Stirrup Leather*, sursingle straps, &c.; Ira Genung, Newark, Essex county, New Jersey, July 30.

Knives, bent into the proper shape, are to be secured upon a joint, or bed, of wood, with their edges rising a quarter of an inch, more or less, above the wood. Punches, or rows of prickers, may also be fixed in the block, with their edges and points upwards. Upon these, the strap to be cut, punched, and pricked, is to be laid, adjustable side strips keeping it in its place. A driver, or follower, consisting of a piece of wood adapted to the purpose, is then brought down upon the leather. When the leather is to be punched, pieces of lead are fixed in the follower, to receive the edges of the punches. There is no claim made, the whole machine, therefore, must be considered as new.

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66. For a *Thrashing Machine;* Benjamin Maltby, Gates, Monroe county, New York, July 30.

This machine differs from many others in nothing excepting the particular mode in which it is to be put together; a thing which is a mere matter of fancy. The claim is to the operative part of the cylinder, in connexion with the concave, and the manner of stationing the concave and cap to the cylinder.

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67. For a *Churn;* Johnson Mewhinney, Liberty, Butler county, Ohio, July 30.

The body of the churn is to be a box with a semi-cylindrical bottom, the sides straight, and the top square; a shaft, carrying dashers, is to pass through it, and it is to be turned by a cog wheel, meshing into a pinion on the shaft.

Further we need not say, as the individual parts possess no more novelty than does the general construction; and those who have read our lucubrations, for a short period only, will be able to pronounce at once upon this point.

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68. For an improvement in the *Printing Press;* Otis Tufts, Boston, Massachusetts, July 30.

This improvement consists in a mode of forcing forward the bar,

or driving lever, which acts upon the progressive levers, or toggle joint; the arrangement of the machinery being such as to cause this to be done in nearly a direct line. It would require a drawing to explain the precise mode of effecting it, but the skilful machinist will, probably, catch the general idea from a short description. The lever with which the pull is made, has two projecting pieces at the head of it, giving it somewhat of a T form; in one of these projecting pieces, there is a friction roller which bears against the face of a piece of metal, which may be cast with, or attached within, the frame, or cheek, of the press. The opposite projection, through the intervention of a jointed lever, forces the pitman forward, upon the progressive levers. We think the arrangement a very good one, and a real improvement on this part of the printing press.

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## SPECIFICATIONS OF AMERICAN PATENTS.

*Specification of a patent for a Hydrostatic Safety Valve for Steam Boilers. Granted to* THOMAS EWBANK, *city of New York, August 27, 1832.*

*With a Copperplate.*

To all whom it may concern, be it known, that I, Thomas Ewbank, of the city of New York, have invented a new safety valve, for the boilers of steam engines, which I denominate the hydrostatic safety valve, and that the following is a full and exact description thereof.

The form of my safety valve may be the same as that ordinarily used, namely, a truncated cone; instead, however, of being pressed downwards in the usual way, it is pressed upwards, by the weight of a column of water, mercury, or other fluid.

In the accompanying drawing those parts which are similar in the different figures are represented by the same letters.

Fig. 1 represents a section of the vessels by means of which the hydrostatic pressure is made. A, is an inner cylindrical vessel, which may be open at top, but is closed at bottom. This is placed within a second vessel, B, which is to contain water, or other fluid, by which the pressure is to be made. It is evident that when the vessel A is placed within the vessel B, and water is poured into the cavity between them, A will be pressed upwards with a force proportioned to the area of the bottom of A, and the altitude of the fluid in the cavity. C is a shallow vessel in which B stands, and is intended to receive any fluid which may escape from B. D, E, F, are cocks placed in B, to regulate the height of the fluid, and consequently to graduate the pressure; say to 50, 40, 30, and 20 lbs. to the square inch. G is a disk of wood, or other light material intended to stiffen the bottom of A, and which may also serve to receive the lower end of the valve rod, each end of which passes into cavities without the use of joints as ordinarily made.

Fig. 2 is a section of the valve in action. H, H, is a tube, one or

both ends of which open into the boiler at I, I. The inverted valve seat is seen at J in the upper part of this tube. K, K, are ledges to support the hydrostatic apparatus above the boiler. A piece of plank, or other bad conductor, is usually first placed upon the ledges. The valve L is drilled deeply on its lower side, to receive the rod M, the lower end of which rests on G.

Fig. 3, is a perspective view of the whole apparatus, the graduation by means of the corks being represented by figures.

As the steam in blowing off passes downwards, I usually place a cover on the vessel A, as shown at N, Fig. 4. A hole left in the centre of this cover allows the rod to play through, and a collar, O, formed upon the rod may cover the holes.

Fig. 4, represents a valve in its usual position, this section shows two holes drilled through the valve at P, P. I intend sometimes to drill a number of such holes, to prevent, or lessen, that adhesion which is known to men of science as having been described by Mr. Clement. The same provision is shown at Fig. 5. These holes I intend, in some instances, to connect together by turning grooves on the face of the valve, removing a portion of metal between them.

By the arrangement here described, the danger which arises from overloading the safety valve is entirely obviated, or rendered so difficult. and so palpable, if attempted, as to afford complete security on this score.

I have thus given particular exemplifications of the principle upon which my improved valve operates, not, however, intending to confine myself to the precise arrangement herein set forth, as this may be variously modified, whilst the general principle remains unchanged.

What I claim as my invention is the employment of hydrostatic pressure to close the safety valve; the using of the valve in the reversed position; the passing the ends of the valve rod into cavities prepared to receive them without the use of joints; and the drilling of holes through the valve, as above described, in order to prevent adhesion.

THOMAS EWBANK.

*References to the Plate.*

Fig. 1. Section. A, the inner cylinder closed at bottom. B, outer cylindrical vessel containing the water. B, lower vessel to receive the waste water from B. D, E, F, cocks to regulate the height of the water.

Fig. 2. Section of the valve in action. H, H, tube opening into the boiler at I, I. J, inverted valve seat. K, K, ledges or brackets which support the apparatus. L, valve. M, valve rod.

Fig. 3. Exterior view. The numerical figures exhibit the graduation by means of the cocks.

Fig. 4. Section, showing N a cover to the middle vessel, and O, a collar on the valve rod, to prevent the steam entering it; holes are also shown as drilled through the valve to prevent adhesion. These

are also shown at P, P, Fig. 5, where the valve is in its ordinary position.

Fig. 6. In this figure the dotted lines show how a tube may be placed to direct the steam upwards.

Fig. 7 shows a glass tube, substituted for the graduating cocks. This tube communicates at bottom with the water in the vessels; it is open at top, is graduated, and protected by a metallic case, with a slat its whole length to allow the height of water to be seen, the graduations being made either on the tube or its casing.

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*Remarks by the Patentee.*

The defects in, and abuses of, the ordinary safety valve, which I have attempted to avoid in this, are,

1st. *The facility of overloading it, and that to any extent.*—This defect is greatly diminished, if not entirely obviated, in the hydrostatic valve; for when the extreme force of steam intended to be used in a boiler is determined, the diameter of A, and depth of B, are regulated to the pressure required, so that when the cavity between them, is *filled* with water, (or whatever fluid they are designed for,) the amount of pressure on the valve is then at its maximum: it cannot be increased: consequently, the elastic force of the steam can never rise higher than is sufficient to open the valves against that pressure.

The cocks are merely to ascertain, if desirable, the force of the steam when *below* its maximum.

2. *The strength of steam required to open the common valve cannot accurately be ascertained.* This arises from several causes, as *the friction of the lever and connecting rod joints;* which, from rust, &c. is often considerable, and cannot be exactly calculated, because not uniformly the same; *the mode of raising the valve by the lever,* which has a tendency to draw the top of it towards the fulcrum, and to move its spindle in an opposite direction to one side of the hole in the guide piece, against which it rubs; *uniting the valve to the lever by bolts* through the connecting rod, increases the evil, because the necessary play of these bolts, and the wear of the holes, prevent the true centre of pressure from being always precisely on the centre of the valve; consequently, the steam cannot raise it perpendicularly, but will influence it in an oblique direction, towards that side on which the external pressure is greatest; this will, of course, move its spindle in a contrary way when it binds itself against the guide piece as above mentioned. Its resistance, in such circumstances, will increase with the increasing force of the steam.

In the hydrostatic valve the whole of these defects are avoided. The bolts and lever are not used at all; and the rod which communicates to the valve the pressure against it, being tapered at its ends, presses only on its central points in countersunk holes; one on the under side of the valve, and the other on a piece of iron or brass attached to the bottom of vessel A. There is no friction in obtain-

# Ewbank's Hydrostatic Safety-Valve

Fig. 1.

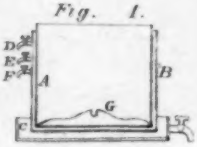



Fig. 2.

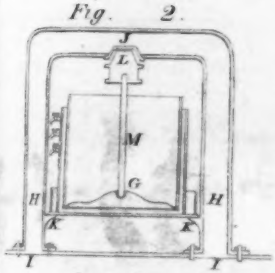



Fig. 3.

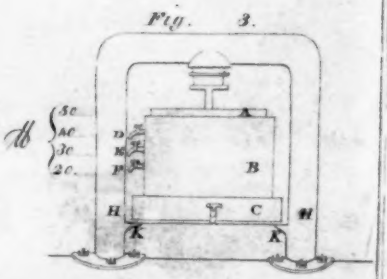



Fig. 5.

Fig. 4.

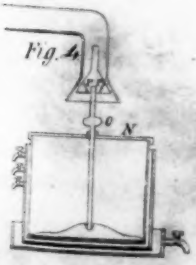
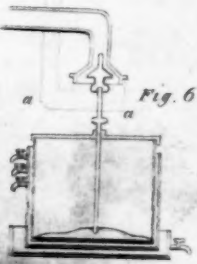
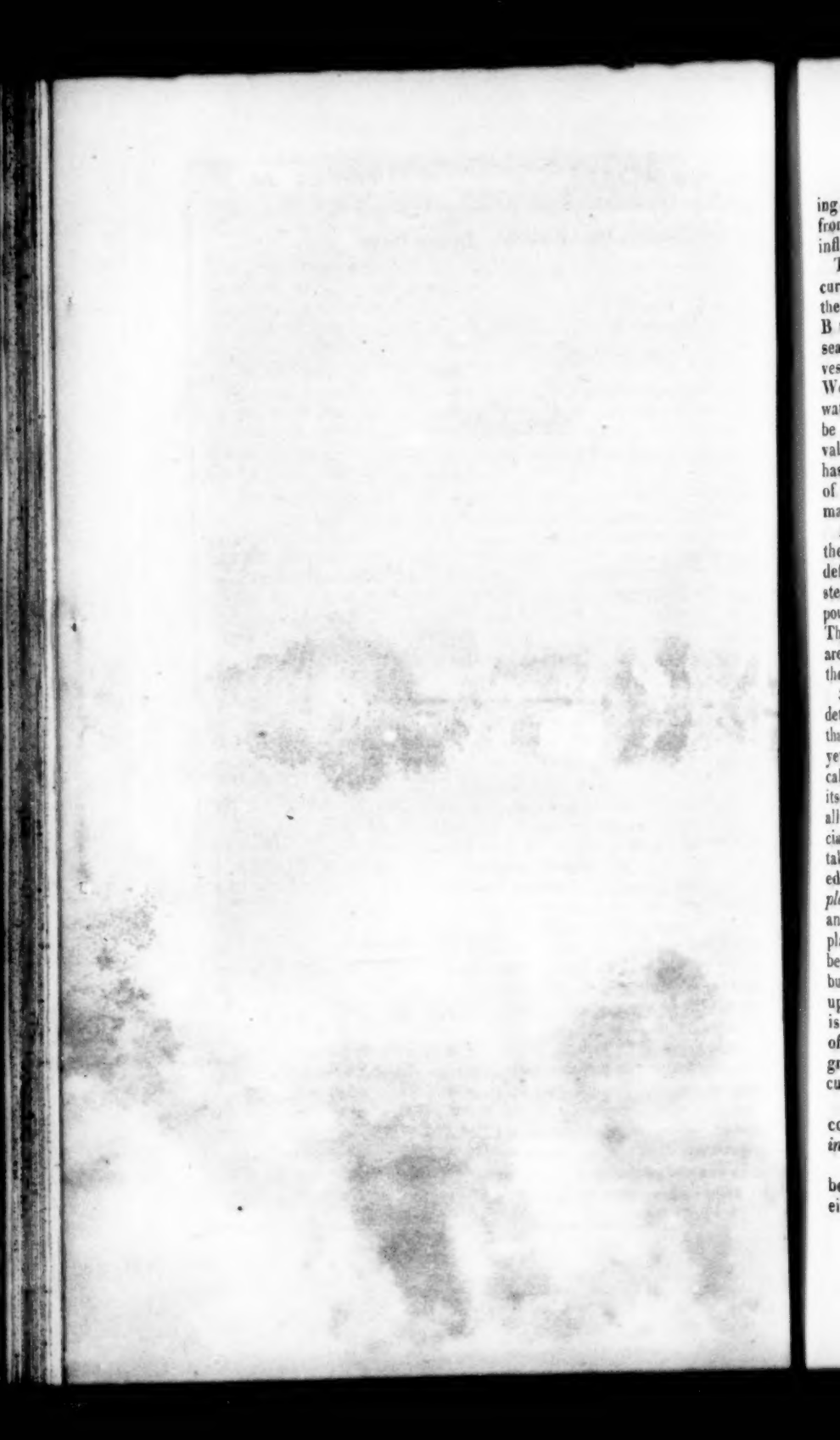



Fig. 7.

Fig. 6.





ing the pressure on this valve, and nothing to prevent the steam from opening it in a perpendicular direction. It is left freely to its influence.

The *amount of pressure* upon it is also very simply, and most accurately made known, *even to the fraction of an ounce;* thus, when the valve, rod, and vessels, are in their places, water is poured into B till it rises to the brim; then by disconnecting the valve from its seat, and allowing the water to act freely on the inner vessel, this vessel, A, will instantly rise, from the pressure of the water in B. Weights are then put into, (or upon,) A, sufficient to sink it, till the water rises to the brim of B, as before; and the amount of these will be the greatest pressure which can be obtained by it against the valve. In putting in the weights it will be found that when the water has risen near to the top of B, the addition of one-fourth or one-half of an ounce weight, will very sensibly affect it. The same method may be taken in ascertaining the position of the cocks.

In one of these valves, which I have had in use for several months, the action has been surprisingly accurate, and I am not aware of any deficiency in it whatever. I have frequently found that when the steam has risen high enough just to open it, a wine glass of water poured into B, (if not filled at the time,) would instantly close it. The diameter of A is thirteen, and depth of B twelve inches. They are made of sixteen ounce copper, and when B is filled with water, the pressure on the valve is fifty pounds.

3. After the maximum strength of steam intended to be used is determined, great caution is necessary in adjusting the *common valve,* that no more than the relative pressure be permitted to act upon it; yet there is reason to believe that, in many cases, nothing more is calculated than the mere weight *on* the lever; the weight of the valve itself, the rod, bolts, and lever, not being taken into the account at all, although their united weight may be of much importance, especially on small valves. But, in some instances, when they have been taken into the account, (as the foreman of an engine factory informed me,) they were only weighed together, *before being fixed in their places.* That this is a material oversight is evident, since their weight, and the power which they exert on a valve when fitted to their places, are essentially different; thus, a rod, valve, lever, and bolts belonging to a boiler I have in use, weigh together only four pounds, but when in their places, the pressure of the lever on the valve, is upwards of twelve pounds; and as its area is but 1.5 inches, there is a pressure on it, *before any weight whatever is placed on the lever,* of more than eight pounds on the square inch! an amount of too great importance to be overlooked, and more especially where mercurial gauges are not used to correct any errors of the lever.

In the hydrostatic valve it will be seen that all inaccuracies and consequent danger from these sources are wholly prevented *by its inverted position.*

4. The common valve when opened by an excess of steam, may be, and often is, improperly closed before that excess is discharged, either by increasing the weight on the lever, or moving it further

from the fulcrum; (and in this manner the pressure on the common valve may be increased indefinitely, at the pleasure of the attendants,) but the hydrostatic valve cannot be closed at all till the steam has subsided to its prescribed force, when it will shut of its own accord. Indeed the steam must subside a little *below* its extreme force before the valve can be closed again, because by its opening, the vessel A is depressed, which expels a portion of the fluid out of B, and the pressure on the valve is therefore diminished in proportion to the quantity of the fluid so expelled.

5. Common safety valves are generally made so as to be, when closed, level with, or a little above the tops of their seats; in consequence of which, when opened, steam issues from them in nearly a horizontal direction; and "as a strong current of air will be created by the velocity of the steam, and will pass off with it, the surrounding air will follow, and in its course will impinge on the valve, and cause a pressure:" but if the seat be made to project two or three inches above the closing part of it, and *incline a little inwards at the top*, and is of sufficient diameter to allow the steam to escape freely between its sides and the periphery of the valve, the steam would then issue in a column directly over it, and so prevent the influence of any atmospheric pressure whatever.

To derive the greatest advantage from this principle is the design of drilling a number of holes all round the closing part of the valve; which holes terminate on the top in a direction towards the centre. When it is opened, steam will pass through these openings in a quantity sufficient to destroy any partial vacuum that could be formed upon it by the lateral escape of the steam. These holes may be advantageously united by a groove turned around it, through them. It is not material that the valve should be tight to its seat on both sides of this groove; if it is so on that next the boiler, it will be sufficient.

The want of uniformity in the construction of safety valves, chiefly, induced me to propose these holes, to avoid any possible effect from steam forcibly escaping from a small orifice, under a valve or disk, in a radiant or star like form, as discovered by Mr. Clement. In very flat valves, which *overhang their seats*, and such there are, these holes may be serviceable; at the same time, I think it doubtful, whether a properly made conical valve, whose orifice is very little less than the valve or disk itself, would be much benefitted by them, except so far as they lessened the area, and adhesion to that amount, and what effect they might produce on the expansion of the metal and adhesion from that source.

Perhaps there is no part of an engine to which less attention is paid, than to the *proper angles* of the cone, or closing part, of safety valves. They vary, as fancy or caprice directs, from one degree to ninety; from a flat surface to nearly that of a cylinder! I do not know that the most eligible angle has ever been determined, but experience has led me to prefer that of forty-five, or near it; for if it be much less, that is, if it approach much nearer to the form of a cylinder, it would be more liable to adhere to its seat from expansion,

or other causes; and if the angle were greater, it would be more subject to the resistance observed by Mr. Clement.

6. It has sometimes occurred to me, that in accurately calculating the amount of pressure on a valve, allowance should be made for atmospheric pressure on the area of its closing parts: thus, a valve which is perfectly fitted to its seat may be turned upside down without separating from it, provided its weight be not equal to the atmospheric pressure on the parts in contact. And as the matter that accumulates on valves soon renders them perfectly tight, if not originally so, perhaps a deduction should be made accordingly. It is said, however, by some persons, that atmospheric pressure has nothing whatever to do with the adhesion of valves, but that they are held to their seats by cohesion, or the mutual attraction of their particles: if, however, the existence of this cohesion depend on the exclusion of the air from between the parts in contact, the pressure consequent on that exclusion must be overcome, *exclusive* of what further resistance is created by cohesion: and again, if cohesion also depend on the immediate contact of the particles of the valve and seat with each other, it is obvious that this can seldom take place, as valves are soon covered with saline and other matters which prevent that contact. But if cohesion were totally destroyed, would not a valve be still subject to atmospheric pressure on the area of its closing parts?

Some valves, as in steam-boats, &c. present an area of the parts fitted to the seats of two square inches and upwards; hence, if my opinion is correct, there is a pressure of thirty pounds from this source alone. But whether this adhesion be caused by atmospheric pressure, or by cohesion, while the effect is nearly the same, there can be no harm in making the calculation in the manner suggested.

The elevation of the hydrostatic valve above the surface of the boiler, and its inverted position, will probably render it less liable to adhesion than the common one, from any other source than that just mentioned. A portion of condensed steam constantly collects above it, and occasionally oozes out, and this circumstance alone may be very beneficial, by preventing the formation, or accumulation, of saline or other substances upon it, and even by lessening, if not destroying, the atmospheric pressure itself.

THOS. EWBANK.

*New York, December* 1, 1831.

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*Specification of a patent for a mode of manufacturing Rollers of Cast Iron for laminating or flattening of metals, and for other purposes. Granted to* JAMES WOOD, *of the city of Philadelphia, July* 20, 1831.

I MAKE a shaft of cast or wrought iron, or of steel, or combinations thereof; upon and around this shaft I afterwards cast iron, so as to form the intended cylinder, or flatting mill roller, of the size, and

adapted to the purpose intended. This casting I sometimes effect in one operation, and at other times I complete it in successive operations. The final casting, by which the surface of the roller is formed, is usually made in a *chill*, or mould, of cast or wrought iron, turned perfectly true, and so constructed as to receive and retain the shaft, first named, exactly in its centre. The roller so cast, either chilled or not, may afterwards be dressed by grinding in the usual way, and the gudgeons, if necessary, may be turned. Such rollers may have grooves of various forms made in them, by preparing the *chill*, or iron mould, with such projecting rims, or ridges, as may be required.

What I claim as new, and for which I ask a patent, is the casting of iron rollers, either chilled or not chilled, for flattening or rolling metals, or other substances, upon shafts of steel, wrought or cast iron, or combinations thereof.

JAMES WOOD.

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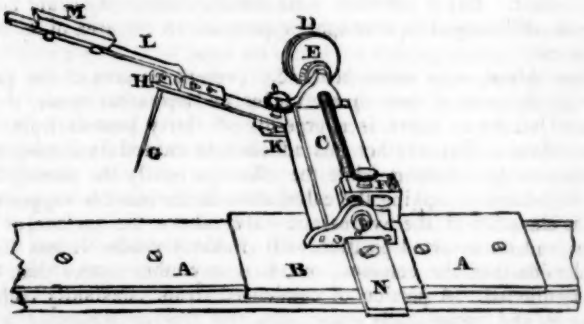
*Engraving Machine. Invented by Mr. Jobard.*




THE experimental results of the above invention obtained for Mr. Jobard the large gold medal from the society for the encouragement of arts in Paris, in 1828. It is composed of a brass rule, A, one metre long, upon which slides a socket B, its internal divisions being furnished with flat steel springs. A very fine and closely wormed screw C, provided with a button D, and containing divisions E, is used to space out the lines according to the required distances. It plays in a bed F, which opens, in order that the screw may be returned without loss of time when it has gone its whole length; G is a steel graver, armed with a finely pointed diamond: a small vice H, fastens the point. A button I, furnished at the base with an inclined plane that moves upon a fixed appendix K, serves to keep the point raised when not required for use. A small square bar to which is fixed a cup M, receives leaden weights that communicate delicacy or force to the point of the graver. The piece N is intended to re-

lieve friction of the compartment C; it is attached to the socket or slider B.

Every one knows that it is next to impossible, with manual skill, to cover a somewhat extended surface with parallel lines, preserving a uniform space and consistency. The above instrument we conceive will be found essentially valuable to an engraver; for the only fault with which we can charge the old masters in this branch of art, lies in the inequalities that necessarily exist in the tracing of their grounds, skies, and, above all, in the field of their medals, which, otherwise, were admirably executed. The machine under consideration will remedy this imperfection, and impart to engravings of this class, a precision and velvet-like character extremely agreeable to the eye. It materially lightens the labour of the artist, and, moreover, some descriptions of drawings may be entirely executed by its means.

The following is the mode of laying down a sky upon a plate with this instrument. The first line nearest to the horizon is traced with the cup empty; before commencing a second line, a small shot of about a line in diameter is dropped into the cup: this is continued to the close of the operation by adding a shot to every line. The point being thus each time more weighted, the stroke necessarily becomes broader and deeper.—*Recueil Industriel.*

*** For machine, architectural, and other drawings of the same character, as well as of still life, the graver of Mr. Jobard will doubtless be found not only available, but useful. For the *poetry*, however, of this branch of the art, (if the reader will allow the expression,) no machinery can convey that enchanting effect of which the hand alone seems capable. We strongly suspect that if all the surfaces in a landscape of *Claude*, or *Gaspar Poussin*, to express which this instrument might be rendered available, were to be laid down with it, the result would be flat, hard and *brassy*. The lines, with all their proportions and graduations would doubtless be found mathematically correct; still we believe that that indescribable charm, that vivid effect, the soul of the art, and which seems to be communicable only by the immediate contact of the hand, would be found wanting. For laying down and shading architectural designs, and mechanical diagrams, we repeat that it may be found eminently serviceable.—*Editor Rep. Pat. Inv.*

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## *Fire Engine Suction Pipes.*

Sir,—In some towns in Belgium, the suction hose of the fire engines are made without any internal metal spiral to support them against the pressure of the atmosphere. They are formed, in the manner represented in the following sketch, by winding a broad leather strap round a mandril in a spiral direction, overlapping sufficiently at each coil to allow of a line of copper rivets being inserted.

When the rivets are set very close, and the coils are not above two

inches broad, such hose appear to have sufficient stiffness to answer the purpose intended, and to possess some advantages over those generally used in England.

*Meteorological Observations for December*, 1831.

| Moon. | Days. | Therm. Sun rise. | Therm. 2 P.M. | Barometer. Sun rise. | Barometer. 2 P.M. | Dew point | Wind. Direction. | Wind. Force. | Water fallen in rain. | State of the weather, and Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Inches | Inches. | | | | Inches. | |
| | 1 | 23° | 29° | 29.65 | 29.70 | 12 | NW. | Moderate. | | Clear—overcast. |
| | 2 | 24 | 35 | 29.90 | 29.80 | 18 | W. | do. | | Cloudy do. |
| | 3 | 24 | 32 | 29.60 | 29.60 | 25 | N. | do. | | Cloudy do. |
| ⊗ | 4 | 24 | 31 | 29.50 | 29.40 | 26 | NW. SE. | do. | .4 | Cloudy do. snow in the |
| | 5 | 10 | 22 | 29.60 | 29.80 | 5 | NW. | Blustering. | | Cloudy do. [evening. |
| | 6 | 10 | 22 | 30.10 | 30.10 | 5 | W. | Moderate. | | Cloudy do. |
| | 7 | 14 | 32 | 30.10 | 30.10 | 10 | W. | do. | | Cloudy do. |
| | 8 | 17 | 32 | 29.95 | 30.00 | 12 | SW. | do. | | Cloudy—clear. |
| | 9 | 26 | 31 | 30.00 | 30.00 | 15 | SW. | do. | .14 | Snow—cloudy. |
| | 10 | 20 | 30 | 30.20 | 30.20 | 15 | NE. | do. | | Cloudy—clear. |
| | 11 | 14 | 32 | 30.30 | 30.30 | 13 | NW. | do. | | Clear day. |
| ☽ | 12 | 20 | 20 | 30.10 | 30.10 | 10 | W. | do. | | Clear day. |
| | 13 | 15 | 24 | 30.5 | 30.00 | 5 | W. | Calm. | | Light snow—clear. |
| | 14 | 16 | 24 | 30.20 | 30.24 | 4 | W. | do. | | Cloudy day—snow in the |
| | 15 | 16 | 19 | 30.20 | 30.20 | 8 | NW. | do. | .15 | Cloudy—clear. [night. |
| | 16 | 4 | 22 | 30.10 | 29.80 | 6 | SW. | Blustering. | | Cloudy—clear. |
| | 17 | 26 | 18 | 29.30 | 29.40 | 4 | W. | do. | | Slight snow—clear—very |
| | 18 | 6 | 12 | 30.10 | 31.20 | 3 | W. | Moderate. | | Clear day. [blustering. |
| ⊛ | 19 | 16 | 34 | 29.90 | 29.80 | 11 | SE. | do. | | Cloudy—clear. |
| | 20 | 14 | 22 | 30.5 | 30.5 | 6 | SW. W. | Blustering. | | Clear day. |
| | 21 | 22 | 24 | 29.60 | 29.50 | 14 | SW. | do. | | Clear day. |
| | 22 | 16 | 20 | 29.90 | 30.10 | 1 | W. | do. | | Clear day. |
| | 23 | 5 | 25 | 30.30 | 30.30 | 2 | W. | Moderate. | | Clear—cloudy—snow in |
| | 24 | 33 | 36 | 29.14 | 29.14 | 28 | NE. SW. | do. | .40 | Cloudy—clear. [the night. |
| | 25 | 31 | 35 | 29.90 | 29.35 | 11 | SW. W. | do. | | Cloudy—clear. |
| ☾ | 26 | 21 | 32 | 29.73 | 29.70 | 15 | W. | do. | | Clear—cloudy. |
| | 27 | 19 | 22 | 29.70 | 29.72 | 6 | W. | do. | | Clear—cloudy. |
| | 28 | 26 | 23 | 29.50 | 29.40 | 18 | E. W. | do. | .42 | Snow—cloudy. |
| | 29 | 26 | 32 | 29.44 | 29.44 | 19 | W. | do. | | Cloudy day. |
| | 30 | 12 | 20 | 29.80 | 29.90 | 2 | W. | do. | | Clear—cloudy. |
| | 31 | 14 | 30 | 29.50 | 29.30 | 22 | N. NE. | do. | .19 | Cloudy—snow. |
| | Mean | 18.19 | 26.19 | 29.83 | 29.81 | 11.32 | | | 1.34 | |

| Thermometer. | | Barometer. |
|---|---|---|
| Maximum height during the month, | 36. on 24th. | 30.30 on 11th & 22d. |
| Minimum do. | 4. on 16th. | 29.14 on 24th. |
| Mean do. | 22.19 | 29.83 |